A08663

JOB FINAL REPORT

RESEARCH PROJECT

STATE OF Montana

PROJECT NO. W-120-R-7,8,9

NAME Statewide Wildlife Research

STUDY NO. BG-1.00 Job 1 (Supplement)
(Old No. BG-2.1 Job 2)

TITLE White-tailed deer population characteristics, movements and winter site selection in Western Montana

Period Covered: January 1976 - December 1977

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Date: December 6, 1977

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ABSTRACT

Janke, Douglas M., M.S., Fall, 1977 Wildlife Biology

White-tailed Deer Population Characteristics, Movements, and Winter Site Selection in Western Montana (92 pp.)

Director: W. Leslie Pengelly

White-tailed deer (Odocoileus virginianus) wintering in the Salmon Lake area of western Montana were studied from October 1975 to September 1977. Intensive study from January through March in 1976 and 1977 was intended to determine the population characteristics and food habits of deer wintering at Salmon Lake as well as to determine the factors influencing habitat selection on the winter range. Study during other months was directed toward identifying summer locations of these deer.

Analyses of population characteristics of these deer included determination of numbers, sex and age ratios, mortality, reproduction, physiological condition, and physical measurements. Between 400 and 550 deer used the 19.06 square-kilometer (7.36 sq mi) winter range. Fawn:adult ratios for 1976 and 1977 were 47:100 and 53:100, respectively, indicating good fawn survival. Bucks comprised 65 percent of the adult harvest during either-sex hunting. Hunter harvest was the major mortality factor. Less than one-third of the population was harvested each year. Winter mortality was minimal. Deer were not suffering from severe malnutrition. Conception dates ranged from 23 November to 4 December.

Analysis of food habits indicated grasses and forbs were preferred. Shrubs receiving the greatest utilization included Oregon grape (Berberis repens), chokecherry (Prunus virginiana), serviceberry (Amelanchier alnifolia), and Rocky Mountain maple (Acer glabrum).

Topo-cover types with steep slopes and moderate snow cover were used extensively. Slopes that developed snow-free areas adjacent to dense overstory cover were also preferred. Intensive studies of the potential of broadcast burns for rehabilitating the winter range should be initiated.

Summer locations were obtained for eight deer. These deer migrated an average distance of 13.99 kilometers (8.69 mi) from the winter range.

ACKNOWLEDGMENTS

This study was funded by the Montana Department of Fish and Game (Project No. W-120-R-7 [6098], Study No. BG 2.1, Job No. 2) and by the School of Forestry, University of Montana. The Montana Department of Fish and Game provided housing and vehicles as well as traps, tagging materials, and both plastic and radio-equipped collars used in the study. The Montana Cooperative Wildlife Research Unit and the School of Forestry provided radio-tracking equipment.

John Mundinger, Montana Department of Fish and Game, helped me prepare for the initial field season. His time and advice are appreciated. Richard Blodnick ran snow courses for me during the 1977 field season. Very special thanks go to Harold Knapp, forestry class instructor for the Missoula County high schools, and to his students. These people helped with nearly every aspect of the field work and helped construct all the Oregon traps used in 1977.

Thanks go to Charles Ward and the Western Montana Clinic for donating time and equipment for analyses of blood and urine samples. Charles Ward's interest and cooperation is especially appreciated. I also thank Dr. Les Marcum and my committee members: Lee Eddleman, Bart O'Gara, Les Pengelly, Bob Ream, and Reuel Janson. The instruction and advice they provided helped with every aspect of the study.

I would like to thank my wife, Lori, for her support throughout the study and for her help during the preparation of this thesis.

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CHAPTER I

INTRODUCTION

The Montana Department of Fish and Game is endeavoring to learn more about the wildlife they manage. In western Montana, changes in quantity and quality of wildlife habitat due to logging activities and other human disturbances and increasing numbers of hunters make such knowledge especially important. The Department's objectives are to build and maintain maximum numbers of game, utilize surplus game, and provide recreational opportunities for sportsmen (Mussehl and Howell 1971). To fulfill those objectives Department personnel are learning more about the life histories of the State's game populations as quickly as possible.

In Region Two, which occupies the central portion of Montana west of the Continental Divide, mule deer (Odocoileus hemionus) and white-tailed deer (O. virginianus) are major game species. Over the last 20 years the number of hunters has been increasing while the number of deer harvested has been decreasing. The white-tailed deer harvest has dropped from an average of 4,246 deer/year from 1956 through 1958 to 2,513 deer/year from 1973 through 1975 (Hartkorn and Firebaugh 1976). Increases in predation, starvation, and poaching, as well as more restrictive hunting seasons, diseases, and decreased productivity could all be factors reducing the hunter harvest.

To gain knowledge which enables better management of the white-tailed deer populations, the Department of Fish and Game initiated a study of the white-tailed deer wintering on one of several winter ranges in the Blackfoot Management Unit of Region Two. The Salmon Lake winter range was chosen as the location of this study. The high deer mortality during severe winters and the overutilization of browse that have been noted on the study area since the 1940's indicated that the deer and the resources they used were not in balance. The accessibility of this winter range made Salmon Lake an ideal location for a study of factors regulating deer numbers.

Most of the fieldwork was conducted from January through March of 1976 and 1977. The objectives of the study were to:

1. describe the population characteristics of white-tailed deer wintering in the Salmon Lake area;
2. describe the food habits of those deer;
3. describe the factors governing deer use of the winter range; and
4. determine the summering locations of those deer.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

Location

The study area is located within hunting districts 282 and 283 in the Blackfoot Management Unit of Region Two near the southern end of the Clearwater River drainage 80.5 kilometers (50 mi) east-northeast of Missoula, Montana. The 9.69 square kilometer (3.74 sq mi) study area includes Sections 8 and 17 and portions of several adjacent sections within R14W, T15N. State Highway 209 and several dirt roads pass through the study area (Fig. 1).

The study area is halfway between the northern and southern boundaries of the big game winter range occupied by white-tailed deer, mule deer, and elk (Cervus elaphus). Salmon Lake and the Clearwater River roughly bisect the western half of this winter range which extends from Blanchard Lake on the south to 3.22 kilometers (2 mi) north of Salmon Lake. Elk occupy the eastern half of this winter range. White-tailed deer and mule deer occupy roughly segregated portions of the western half that is shown in Fig. 1.

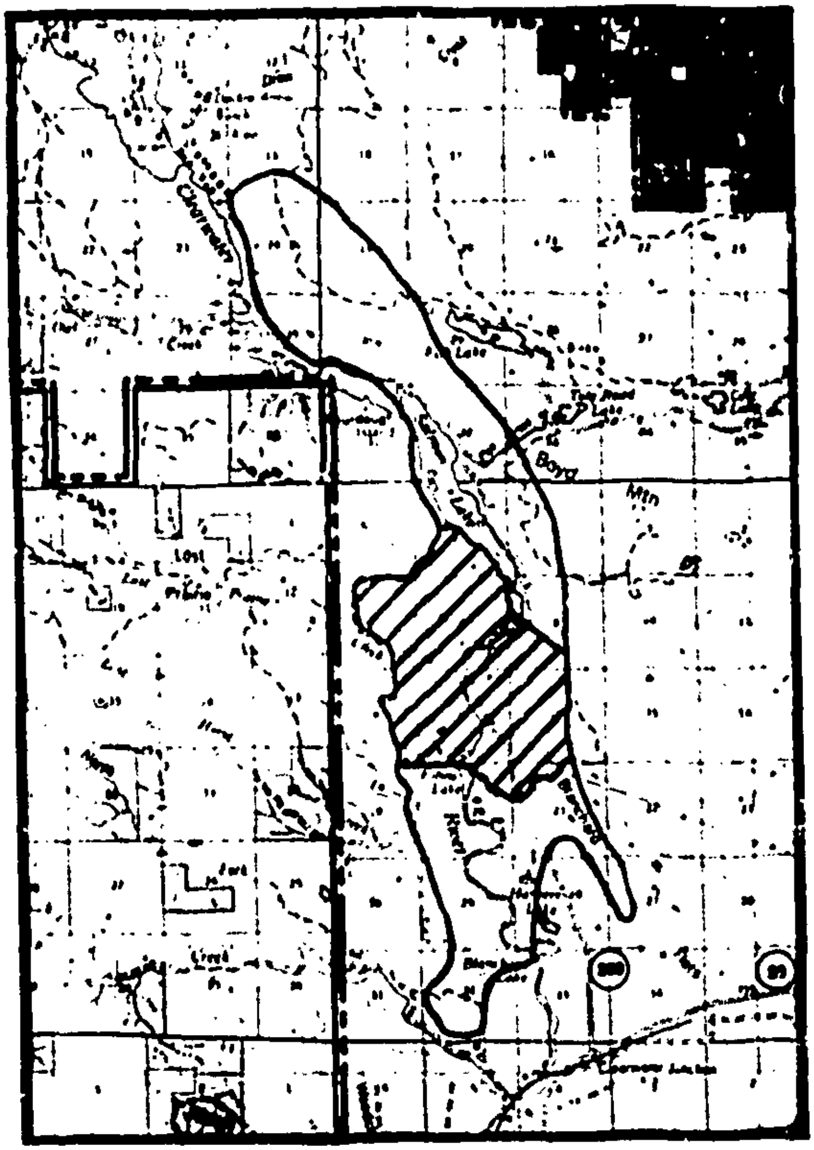
Topography and Geology

Elevations range from 1,170 (3,840 ft) to 1,542 meters (5,058 ft). The south-central portion of the study area is characterized by a kettle and dome topography. Level lowland extends to the east and west from there and meets an east-facing slope on the western edge and

Fig. 1. Salmon Lake study area and the winter range used by deer at Salmon Lake.

White-tail and mule deer winter range

Study area



a west-facing slope on the eastern edge of the study area. The northern half of the study area consists of a high ridge running east to west. The highest point on the study area occurs on this ridge.

The Clearwater River runs through the study area, entering from Salmon Lake in the northeast corner and flowing into Elbow Lake on the southern border. Lost Prairie Creek is a seasonal creek which enters the study area from the west and empties into Elbow Lake.

Gravelly and cobbly loams are the dominant soil types on the relatively level lowland (Anon. 1972). Gravelly loams cover the bedrock on the slopes. Rock outcrops and scree are common on steep south-facing slopes (Anon. 1972). The bedrock in the Salmon Lake area is Pre-Cambrian sedimentary rock of the Belt series and was covered by the Clearwater glacier which extended 3 or 4 miles south of Salmon Lake during the Pleistocene epoch (Alden 1953). The kettle and dome topography in the south-central portion of the study area resulted from the activity as the glacier receded. Blocks of ice were buried by glacial outwash and thawed many years later (Alden 1953).

Vegetation

The study area was habitat typed using the Forest Habitat Types of Montana (Pfister et al. 1974). All habitat types but two that occupy an area adjacent to Salmon Lake on the northern end of the study area are representative of either the _Pinus ponderosa_ series or the _Pseudotsuga menziesii_ series. Bunchgrass habitat types of the _Pinus ponderosa_ series are present in the southeastern portion of the study area. All but four of the 15 habitat types within the _Pseudotsuga menziesii_ series are distributed in a mosaic pattern within the study area. The *Picea/Linnaea borealis* habitat type and *Abies lasiocarpa/Linnaea borealis* habitat type are present on the northern end of the study area along Salmon Lake. Table 1 lists the habitat types present on the study area.

Climate

Weather data has been collected by University of Montana personnel at Lubrecht Experimental Forest since the mid-1950's. The weather station elevation is 1,219 meters (4,000 ft) and is located approximately 19.3 kilometers (12 mi) south of the study area. The warmest month is July with an average monthly temperature of 17.0° C (62.7° F). The coldest month is January with an average monthly temperature of -8.0° C (17.6° F). Annual precipitation averages 45.92 centimeters (18.08 in), 38 percent of this precipitation falling from December through March. Precipitation is greatest in January and June. The driest months are July and August. Average monthly temperatures, average daily maximum temperatures, and average daily minimum temperatures for January, February, and March are given in Table 2. Average monthly snow depths for January, February, and March are given in Table 3.

Analysis of weather data collected from December 1975 through March 1976 by U.S. Forest Service personnel at Seeley Lake 19.3 kilometers (12 mi) north of the study area indicated that rain and snow fell throughout the period. Maximum and minimum snow depths during these 4 months were 86.4 centimeters (34 in) and 25.4 centimeters (10 in), respectively. Snow depths varied by at least 27.9 centimeters (11 in) each month. Every period of precipitation was followed by a period of snow melt.

Table 1. Habitat types on the study area.[1]

Series	Habitat type
Abies lasiocarpa	/ *Linnaea borealis*
Picea	/ *Linnaea borealis*
Pinus ponderosa	/ *Festuca idahoensis*
	/ *Agropyron spicatum*
Pseudotsuga menziesii	/ *Vaccinium caespitosum*
	/ *Vaccinium globulare*
	/ *Linnaea borealis*
	/ *Symphoricarpos albus*
	/ *Calamagrostis rubescens*
	/ *Carex geyeri*
	/ *Arctostaphylos uva-ursi*
	/ *Spirea betuliflora*
	/ *Festuca scabrella*
	/ *Festuca idahoensis*
	/ *Agropyron spicatum*

[1]After Pfister et al. 1974.

Table 2. Winter temperature data from Lubrecht Experimental Forest.

Time	Avg. monthly temp. °C (F)		
	Mean	Minimum	Maximum
1957-1976			
January	-8.0 (17.6)	-13.2 (8.2)	-3.1 (26.5)
February	-4.1 (24.7)	-10.3 (13.5)	2.1 (35.8)
March	-1.5 (29.3)	- 8.4 (16.8)	5.6 (42.0)

Table 3. Winter snow depth data from Lubrecht Experimental Forest.

Time	Avg. snow depth cm (in)
1955-1976	
January	32.5 (12.8)
February	39.9 (15.7)
March	31.0 (12.2)

A mid-January storm left a maximum accumulation of 57 centimeters (22 in) of snow on the study area during the only major snow storm in the 1977 field season. Snow depths decreased through the remainder of the field season and were less than 45.7 centimeters (18 in) by the end of January.

Land Ownership

Major portions of the study area are owned by the Champion International Corporation, Burlington Northern Railroad, and the State of Montana. Minor parcels are held by private individuals and non-profit groups. Fig. 2 details land ownership on the study area.

All but 2.01 square kilometers (0.78 sq mi) of the study area lands are either leased or deeded to the Montana Department of Fish and Game. The 2.01 square kilometers include 0.88 square kilometers (0.34 sq mi) of private land, and 1.13 square kilometers (0.44 sq mi) of Champion International Corporation lands.

Land Use

Logging in the Clearwater River drainage began before 1900 (Archives photo collection, U of MT). Old cruising records of the Anaconda Company, on file at Champion International Corporation's Timberland Division office in Missoula, indicate that cutting began on the study area in the late 1800's.

Fig. 3 illustrates areas cut before 1924. A comment from an 1899 timber cruising report for Section 8 indicated that timber on surrounding sections was "generally cut." The 1902 report said logging was occurring at the present time in Section 19. No logging operations occurred on the study area in the 1930's.

Fig. 2. Land ownership on the study area.

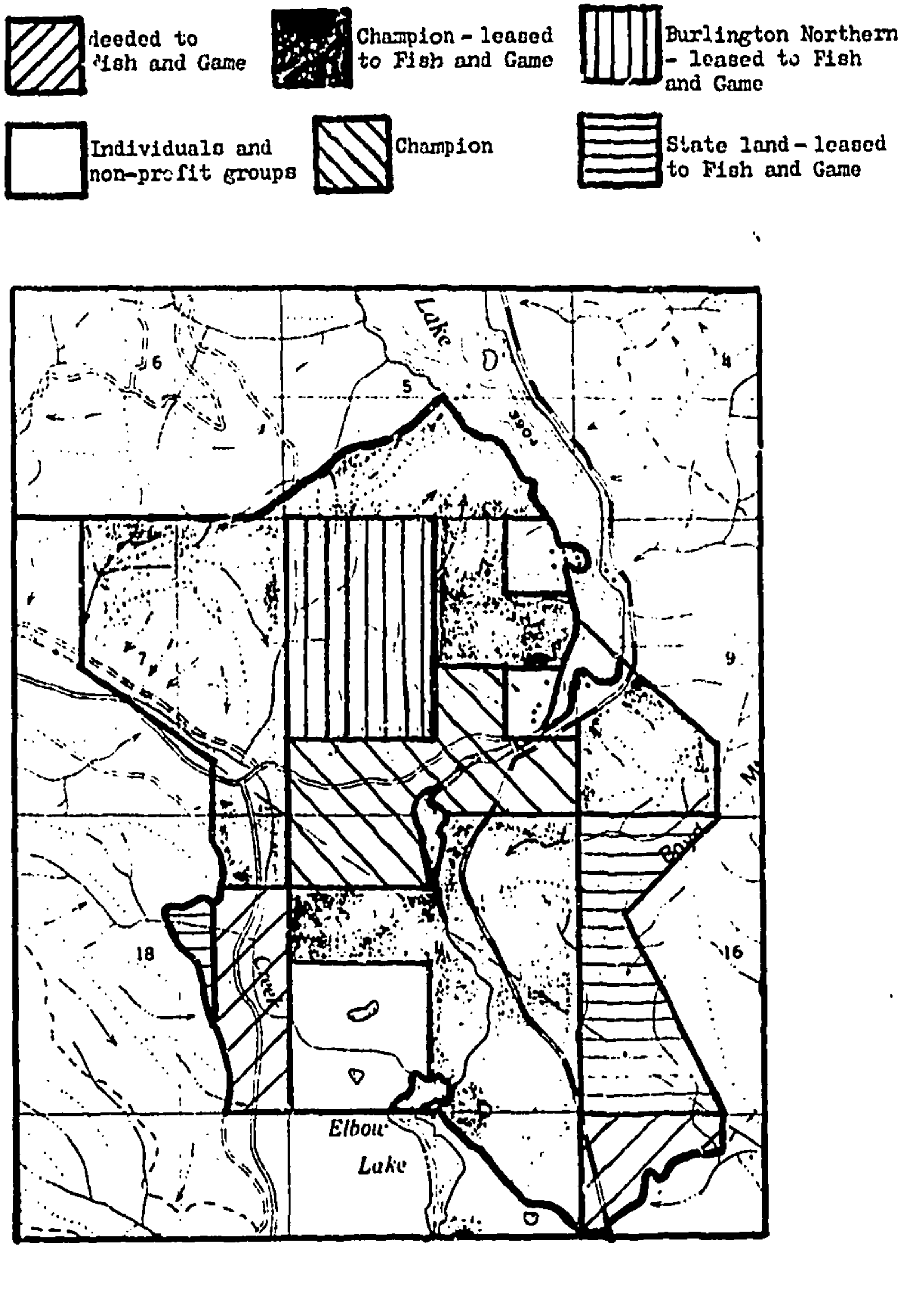


Fig. 3. Logging activities on the study area, 1894 - 1915.

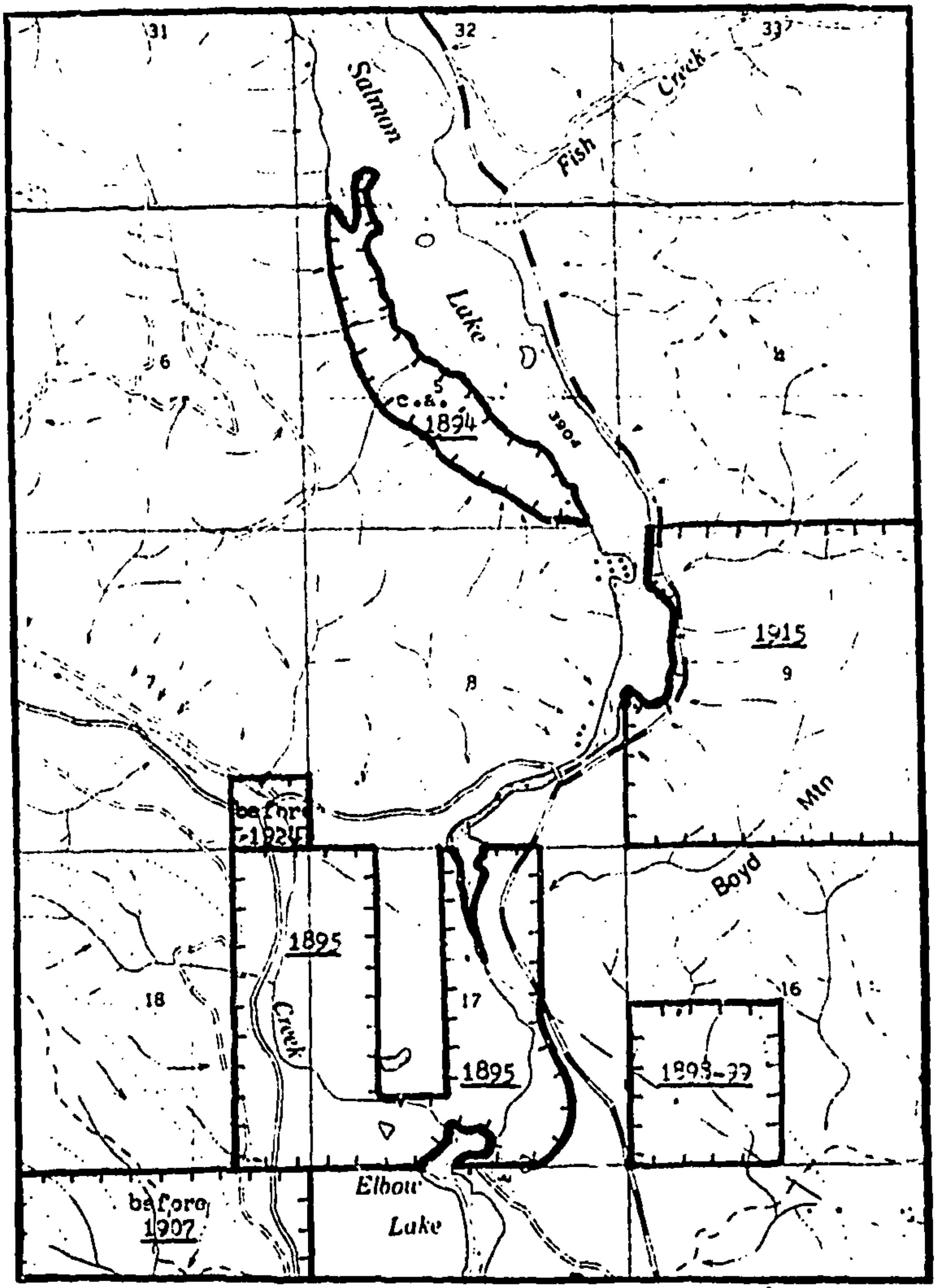


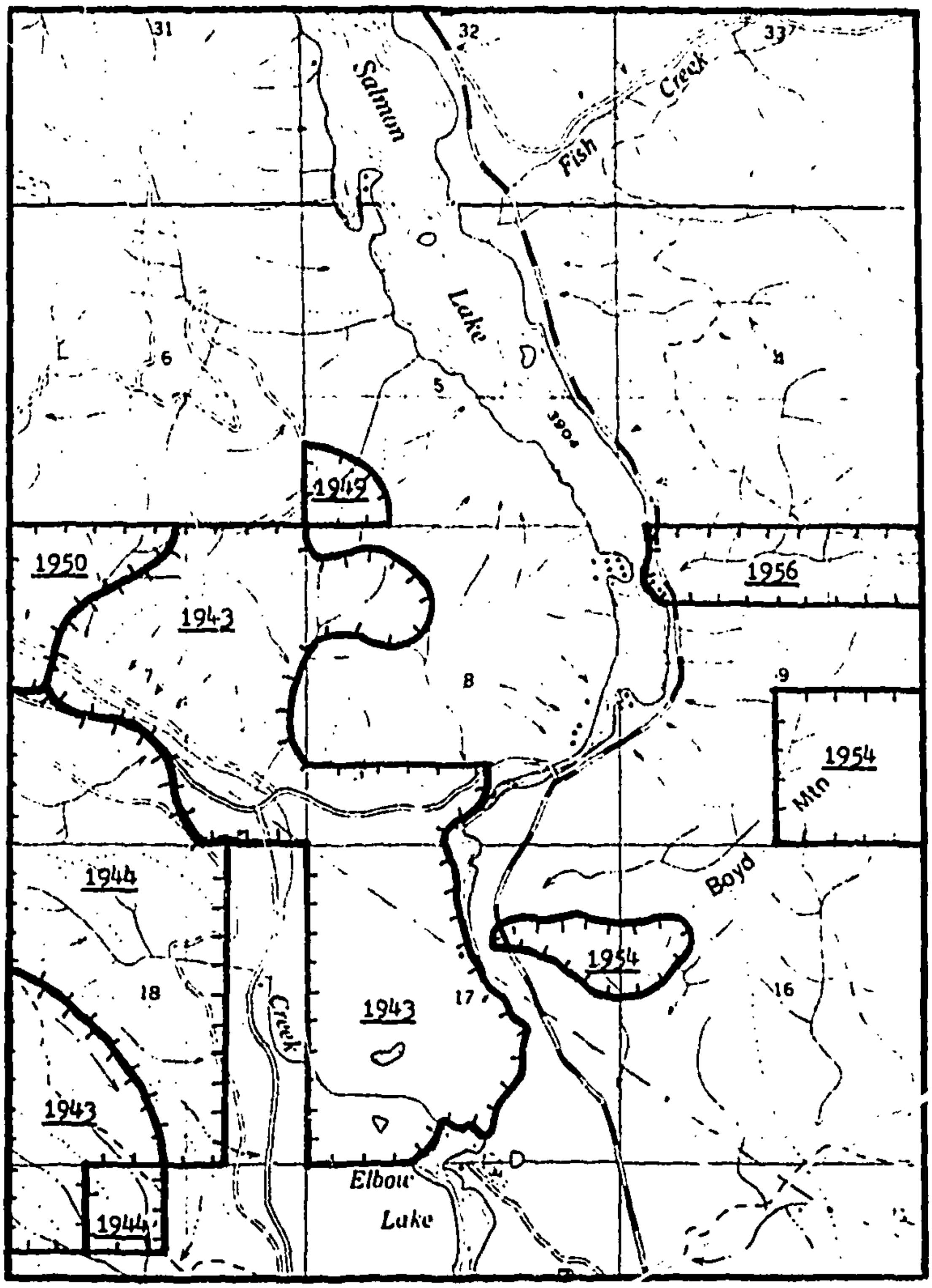
Fig. 4 illustrates areas cut in the 1940's and 1950's. A study of Figs. 3 and 4 shows that some areas were cut twice within 50 years. Joe Sieminski, property manager for the Champion International Corporation, Timberlands Division, informed me that this was due to advances in logging machinery which made it profitable to harvest smaller trees which had been left standing at the turn of the century. Camp Nine was constructed near the northeastern corner of Section 17 in 1947.

Old cruising records also provide a partial history of fire on the study area. Some fire damage was evident on the southern half of Section 8 in 1899. The report for 1924 indicated that a ground fire occurred over most of Section 7 in 1917. The same report indicated an old burn was evident in the area around the eastern border of Section 18.

The dirt road across the southern portion of Section 8 was already in use in 1899. Several private cabins were present on the area by 1924. Today, a Girl Scout camp, a church camp, and a cluster of summer cottages are located at the southern end of Salmon Lake. Summer cottages and another church camp are located around Elbow Lake, and a primitive church camp is located near former Camp Nine. The camps and cottages are used during the spring, summer and fall months.

Cattle graze along Lost Prairie Creek, on the south-facing slope of Section 7 and on ridges of Sections 7 and 8 during the summer. Fishing is permitted in the Clearwater River throughout the year. Grouse and deer are hunted on the study area in the fall. Snowmobile enthusiasts use the southeastern quarter of Section 17 and the northeastern quarter of Section 20 extensively on weekends during the winter months when snow conditions permit. Occasionally, snowmobiles travel

Fig. 4. Logging activities on the study area during the 1940's and 1950's.



the snow-packed dirt roads that cross the study area. Mild winters also enable the use of four-wheel drive vehicles on the dirt roads. Very little trapping occurs on the study area. The portion of the study area east of State Highway 209 is closed to public use from the end of the fall hunting season until spring.

Deer History

By the 1930's, many big game winter ranges were overutilized (Mussehl and Howell 1971). Winter feeding of deer was common on the Salmon Lake winter range. Tex Baker drove a stage between Bonner and Seeley Lake in the early 1900's and occasionally fed hay to the deer in the winter on this overutilized range (Baker, pers. comm.). Anaconda Company employees at Camp Nine and local residents also fed deer on the study area in the late 1940's and early 1950's (L. Pengelly, pers. comm.).

Game technician positions in the Montana Department of Fish and Game were established about 1940 (Mussehl and Howell 1971). The technicians began game surveys immediately. According to a 1943 report, the winter range was used in the summer by sheep, horses, and cattle (Anon. 1943). An estimated 950 white-tailed deer were wintering in the Owl Creek, Drew Creek, Salmon Lake, and Fish Creek area that winter; severe winter weather led to a deer feeding program by the Department of Fish and Game in March and April that year (Anon. 1943).

The 1948 Fish and Game report indicated all deer reached the winter range by 1 December (Gummers and Evers 1948). It was felt that the Salmon Lake Hills, Drew Creek, and Owl Creek areas could support 400 white-tailed deer. This was 180 less than the 580 white-tailed deer estimated to be using the area that year. Three hundred and fifty mule deer, 138 elk, and 12 horses helped the white-tailed deer over-utilize the vegetation. Mullein (Verbascum thapsus) was stripped and grass was severely depleted. Known deer mortality totalled 160. Ninety were harvested and 70 taken by poachers, predators, and car collisions. The same report indicated an excess of 190 white-tailed deer wintered between the lower end of Salmon Lake and Sunflower Mountain, approximately 22.5 kilometers (14 mi) to the southwest. Although no starvation losses were mentioned in the 1943 and 1948 reports, losses did occur (R. Janson, pers. comm.).

As many as 1,000 sheep were managed on the Boyd Ranch adjacent to the southeastern portion of Salmon Lake and on portions of the deer winter range. However, they were moved frequently and were off the winter range by fall (F. Hartkorn and M. Morris, pers. comms.). Livestock browsing during the summer probably was not the cause of over-utilization on the winter range (M. Morris, pers. comm.)

During the winter of 1955-56, severe weather led to a large die-off at Salmon Lake. A dead deer survey in April 1956 covered 4.86 square kilometers (1.88 sq mi) centering on the northern portion of the whitetail winter range that seems to have the greatest deer concentrations. This area overlaps portions of the present study area. Excluding roadkills, 131 recent whitetail carcasses and 175 carcasses from previous seasons were found. The age composition of the dead deer was 60 percent fawns, 21 percent prime, and 19 percent old. Starvation was considered the primary cause of death which amounted to 27 deer/square kilometer (70/sq mi) in the area surveyed. Additional carcasses were present in adjacent areas. Thirty-two roadkills were also collected that winter. Deer densities in the area for the winter were put at no less than 50 deer/square kilometer (130/sq mi) (Hartkorn and Rognrud 1956).

A 1958 Fish and Game report estimated that 340 white-tailed deer were wintering in the Owl Creek, Drew Creek, Salmon Lake, and Fish Lake area. This number represented 41 percent reduction in numbers over 10 years, exceeding the estimated 34 percent reduction in white-tail numbers for the entire Blackfoot Management Unit. However, local residents were still feeding deer, browse was still in poor condition, and conifers were still being browsed (Hartkorn 1958).

The winter of 1961-62 was as severe as the winter of 1955-56. A dead deer survey showed only 15 dead deer/square kilometer (39/sq mi). The percentage of prime animals in the survey dropped while the percentage of fawns rose (Hartkorn 1962). It seemed conditions were improving.

Today, as in the past, livestock are present on the winter range in the summer. Deer die-offs occur in harsh winters (Hartkorn 1970). Table 4 lists the results of dead deer counts on the study area since 1956.

Table 4. Results of dead deer surveys, 1956-1975.[1]

Year	Dead deer per sq km	(sq mi)	Year	Dead deer per sq km	(sq mi)
1956	35	90	1966	7	19
1957	29	75	1967	10	25
1958	15	39	1968	5	12
1959	13	33	1969	28	73
1960	7	18	1970	14	37
1961	3	8	1971	9	24
1962	15	39	1972	18	46
1963	2	6	1973[2]		
1964	17	44	1974[2]		
1965	26	67	1975	31	80

[1]Janson, R. 1975. Clearwater deer mortality survey. MT Fish Game Rep., Dist. 2, Missoula. 3 pp.

[2]Losses believed to have been light.

CHAPTER III

METHODS

Trapping

Clover traps, Oregon traps, and a 12.2 x 18.3 meter (40 x 60 ft) cannon net were used to capture deer. These traps were checked daily. Deer often suffered abrasions, bruises and excessive loss of hair in the Oregon traps. Therefore, these traps were used only in 1976 and were replaced with new Clover traps in 1977.

Clover traps and Oregon traps operated automatically and were designed to capture individual deer. Clover (1956) described the construction and operation of this trap. The cannon net had to be operated by field personnel and was intended for capturing several deer at a time.

Ear tags were placed in both ears and a collar constructed of Armor-tite plastic was placed on the neck of each deer that was captured and released. The collar was colored and had a distinctive pattern painted on it allowing individual identification of each deer. Collars were made in two sizes. Large collars with a circumference of 58.5 centimeters (23 in) were used on males. Small sized collars with a circumference of 48.3 centimeters (19 in) were placed on females. The collars were snugly fitted on adult bucks and all fawns by folding and stapling the excess collar material. The staples would pull out as the neck enlarged. Stapling allowed for expansion of the buck's neck during the rut and for growth of the fawns. Radio-collars with individual color patterns were placed on 10 deer.

Population Characteristics

A description of the population characteristics of this deer herd included determination of numbers, sex and age ratios, mortality, reproduction, physiological condition, and physical measurements. A discussion of the methods employed follows.

Total numbers. Kelker's belt transect method and the Lincoln-Peterson index were used in censusing the deer population at Salmon Lake during the winter field seasons. The Kelker belt transect was described by Robinette et al. (1974). It was run once in 1976 and once in 1977. Separate population estimates were made for the open areas and the closed areas with estimated, perpendicular visibility thresholds of 183 meters (200 yd) and 91 meters (100 yd), respectively. These estimates were added to provide a population estimate for 19.06 square kilometers (7.36 sq mi) of whitetail winter range. The Lincoln-Peterson index was used only in 1976 since it requires that a known number of marked deer be present in the population.

Sex ratio. I attempted sex ratio counts in December of 1975 and 1976. However, deer were not concentrated and dense forest restricted visibility, so collected data were inadequate. Therefore, a sex ratio was determined for the adult deer checked at the Bonner game checking station during the either-sex seasons in 1975 and 1976.

Age ratio. Fawn:adult ratios were obtained during the winter field seasons. An attempt was made to determine the age of each deer observed. Results throughout each winter were summed to obtain a ratio for the entire winter.

<u>Mortality</u>. Mortality can be due to hunter harvest, poaching, predation, starvation, diseases or parasites, collision with cars, or unusual accidents. Data from the game checking station at Bonner and from Montana Fish and Game hunter questionnaires were analyzed to determine hunter harvest. The location of kill was noted for each white-tailed deer checked at Bonner. From the checking station data for hunting districts 282 and 283, I determined what percentage of the white-tailed deer checked at Bonner were harvested from the summer range used by deer wintering at Salmon Lake and what percentage of the white-tails were harvested from all other areas in hunting district 282. Questionnaire results were used to determine the total number of white-tailed deer harvested in hunting districts 282 and 283. These two sources of data were used to determine the total number of deer harvested from the summer range of deer that wintered at Salmon Lake.

Dead deer along State Highway 209 near Salmon Lake and on the study area were observed and/or collected during the winter field seasons. Cause of death was determined when possible.

<u>Reproduction</u>. Fetuses were collected from dead does found throughout the winter. Cheatum and Morton (1946) stated that forehead-rump lengths should be used to determine conception dates. According to Armstrong (1950) the back of the fetus must be straight before this measurement was made. Unfortunately, backs of five of the six fetuses in this study were not straight when measured. Therefore, to salvage those measurements two measurements were made on each of 21 pronghorn

(*Antilocarpra americana*) fetuses. A forehead-rump length was determined using the correct measurement procedure. Then, a forehead-rump length was determined after placing the back of each fetus in a curved position. The difference between the two values was averaged for the 21 fetuses to provide a correction factor that was added to my forehead-rump measurements in this study providing proximate conception dates. Forehead-rump lengths for twins were averaged to determine their conception date as suggested by Armstrong (1950).

I also attempted to determine pregnancy through analysis of estriol levels in deer urine. Urine was collected from one captured doe on the study area by catheterization. It was collected from mule deer and white-tailed deer bucks and pregnant does on the National Bison Range in the winter of 1976-77 during a herd reduction program. In addition, urine-snow mixtures were collected from the Salmon Lake study area.

If estriol levels in pure urine samples would differentiate males from females and pregnant from non-pregnant females, then urine-snow mixtures would be reconcentrated by lyophilization and analyzed for estriol. The results could indicate the percentage of females that were pregnant and the sex ratio of the population.

Physiological condition. The bone marrow compression test (Greer 1968) and blood analysis were used to determine the winter condition of deer. Approximately 35 cc of blood were collected from cannon-netted deer. Generally, blood from all deer was drawn within 20 minutes of capture and centrifuged within 2 or 3 hours of collection. Serum parameters analyzed included blood urea nitrogen (BUN), non-esterified fatty acids (NEFA), and triiodothyronine (T_3). The latter two were analyzed only for blood samples collected during the 1977 field season.

Physical measurements. Physical measurements were recorded for hog-dressed deer brought through the Bonner checking station and for trapped deer when sufficient manpower and time were available. Measurements recorded included weight, hind foot length, total length, total antler points, and antler beam diameter. The maximum and minimum diameters were averaged on each beam. These values were averaged to provide the antler beam diameter values.

Food Habits

Three methods were used to determine winter food habits of white-tailed deer during the 1976 and 1977 field seasons. Rumen analysis was used on samples collected from roadkills, predator kills, and trap mortalities. Percent occurrence by volume was determined for each plant species in the rumen samples. Employees of the Montana Department of Fish and Game at the Bozeman laboratory analyzed the samples.

Eleven browse transects were set up in nine topo-cover types over the study area to determine food habits in 1976. A steel tape was used to mark off 1.2 meter intervals. In each transect, the total number of browsed and unbrowsed leaders of current annual growth (CAG) and previous years growth (PYG) were counted on the one shrub or evergreen seedling nearest every 1.2 meter (4 ft) interval until 40 plants had been studied. The number and percentage of leaders of CAG and PYG that were browsed were determined for each species. The following species were observed: serviceberry (*Amelanchier alnifolia*), chokecherry

(*Prunus virginiana*), Rocky Mountain maple (*Acer glabrum*), rose (*Rosa* spp.), dogwood (*Cornus stolonifera*), willow (*Salix* sp.), ceanothus (*Ceanothus velutinus*), juniper (*Juniperus communis*), and Douglas-fir. The location of each transect is shown in Appendix I.

In 1977, food habits were determined by counting the number of bites each shrub species received in 2 x 2 meter (6.6 x 6.6 ft) plots which were established at regular intervals along deer trails and tracks. Twig tips that were obviously decadent indicated feeding had occurred at least several months in the past and were not considered. The number of bites per plot were counted for the following species: spirea (*Spirea betulifolia*), snowberry (*Symphoricarpos albus*), dogwood, chokecherry, serviceberry, Rocky Mountain maple, willow, rose, ceanothus, Oregon grape (*Berberis repens*), Douglas-fir, and ponderosa pine. An index of shrub utilization was determined by the total number of bites taken of each species.

Extent of the Winter Range

The boundary of the whitetail winter range receiving extensive use during mild winters was determined by noting the number of frequently used deer trails as well as the occurrence and number of individual tracks and pellet groups in the snow. Also, deer sightings during systematic searches of the study area were used to indicate the areas where deer concentrated.

Use of the Winter Range

Winter habitat use by whitetails was studied within 17 topo-cover types that were defined on the basis of topographic and overstory density characteristics (Appendix II). The name and number assigned to each topo-cover type as well as the area of each topo-cover type are given in Table 5.

Topo-cover types receivin high and low levels of use were determined through analysis of browse utilization data from browse transects and from 2 x 2 meter (6.6 x 6.6 ft) plots. The number of deer I saw per mile walked in each topo-cover type during systematic searches was used for the same purpose.

Physical characteristics were measured in eight topo-cover types during 1977 to determine what factors influenced selection of certain types. These physical measurements were made at regular intervals while back-tracking deer and included aspect, percent slope, overstory density, aggregate shrub cover, shrub cover of heavily used and lightly used species, and presence of grasses and forbs. The number of elk and coyote (<u>Canis latrans</u>) tracks were recorded as well. Snow courses were run in 11 different topo-cover types including seven of the types for which physical characteristics were determined (Table 5).

Summer Distribution

The summer distribution of deer wintering at Salmon Lake was determined by locating the radio-collared deer during radio-tracking flights from April through September in 1976 and 1977. In addition, during the summer of 1976, personnel from the Department of Fish and Game, U.S. Forest Service, Burlington Northern, and the Blackfoot Rural Telephone Cooperative were given a list of collar patterns and colors being worn by deer at the time. These people were contacted later in the summer to obtain information on deer sightings. Also, I systematically travelled the logging roads in the Clearwater River drainage

Table 5. Topo-cover types on the Salmon Lake study area.

Topo-cover Type Name topography	overstory	Number	Area percent	hectares	(acres)
Ridge top	dense	1	0.2	1.9	(4.7)
"	intermed.	2	4.0	38.8	(95.8)
"	open	3	1.6	15.5	(38.3)
North-facing	dense	4 *[1] +[2]	14.3	138.5	(342.1)
South-facing	dense	5 * +	2.0	19.4	(47.9)
"	intermed.	6 * +	13.9	134.6	(332.5)
"	open	7 +	3.1	30.0	(74.1)
East-facing	dense	8 *	4.7	45.5	(112.4)
"	intermed.	9 +	1.9	18.4	(45.4)
West-facing	dense	10 * +	7.4	71.7	(177.1)
"	intermed.	11 * +	11.7	113.3	(279.9)
"	open	12 +	0.8	7.7	(19.0)
Lowland	dense	13	3.6	34.9	(86.2)
"	intermed.	14 * +	9.3	90.1	(222.5)
"	open	15 +	6.9	66.9	(165.2)
Kettle-dome	dense	16	3.6	34.9	(86.2)
"	intermed.	17 * +	8.4	81.4	(201.1)
Water		-	2.6	25.2	(62.2)
			100.0	968.7	(2,392.6)

[1] * = Physical characteristics measured.

[2] + = Snow depths measured.

during the summer of 1976 attempting to locate marked deer. During the 1976 hunting season, hunters passing through the Bonner checking station were questioned concerning sightings of collared deer.

CHAPTER IV

RESULTS

Trapping

A total of 53 deer were trapped and released during the 1976 and 1977 winter field seasons. Forty-five deer were trapped in 1976 and eight were trapped in 1977. Trap mortality occurred during three initial captures and two recaptures. Thirteen of 53 deer were recaptured a total of 24 times. Ear tag numbers, collar descriptions, and capture dates of deer not recovered by September 1977 are given in Appendix III.

Population Characteristics

Total numbers. The portion of the Salmon Lake big game winter range used extensively by white-tailed deer covers 19.06 square kilometers (7.36 sq mi). An area north of Salmon Lake and south of Drew Creek occupied by whitetails is not included. The 1976 Kelker strip census indicated a total of 474 deer or 25 deer/square kilometer (64/sq mi) on this winter range; however, the 1977 Kelker strip census indicated only 342 deer or 18 deer/square kilometer (47/sq mi) on the same area.

The Lincoln-Peterson method was used only in 1976 since the total number of marked deer returning to the winter range in 1977 was unknown. The estimate was applied to 11.6 square kilometers (4.48 sq mi) centered on the study area on the northern half of the whitetail winter range. All trapping occurred at the north end of the winter range and marked deer on the northern end may not mix with deer on the southern end (see Discussion). Because only three of 48 sighted deer had collars, Bailey's correction factor was used (Emmel 1976). Thirty-six deer had been collared, but there was evidence that some males were removing the collars by popping the staples. For example, one adult buck was captured three times and had removed its collar before each recapture. Another deer kicked off its collar immediately after its release. An estimated value of 31 marked deer was used assuming that 50 percent of the males had lost their collars. The population estimate as determined from calculations using a value of 31 marked deer was 384 deer or 33 deer/square kilometer (86/sq mi) for the northern portion of the winter range. If the deer density was similar on the southern portion of the winter range, the entire population would total 633 deer.

Sex ratio. Bonner checking station data for the harvest of adult deer during the either-sex hunting seasons in 1975 and 1976 are shown in Table 6. The combined results for both years showed that 65 percent of adult deer harvested from the summer range of whitetails that winter at Salmon Lake were males. The results of the harvest for the rest of the Blackfoot Management Unit showed 46 percent of the adult deer harvested were males.

Age ratio. In 1976, 66 deer were classified during winter field observations. Twenty-one were classified as fawns. This was equivalent to a fawn:adult ratio of 47:100. In 1977, 135 deer were classified; 88 were adults and 47 were fawns. This was equivalent to a fawn:adult ratio of 53:100.

Only deer that were accurately classified were used in the age

Table 6. Adult sex ratios for deer checked at Bonner during either-sex hunting seasons, 1975 and 1976.

Location of whitetail harvest	Males number	Males percent	Females number	Females percent
Summer range of deer wintering at Salmon Lake	40	65	22	35
Rest of Blackfoot Management Unit	56	46	67	54
	96		89	

ratio determinations. The results for 1976 and 1977 were similar to results determined for all whitetails in hunting district 283 since 1971, except 1975 (Table 7). The severe winter in 1975 may have seriously reduced fawn survival, causing the low fawn:adult ratio of 34:100.

Table 7. Fawn:adult ratios in hunting district 283.

Year	1971	1972	1973	1974	1975	1976[1]	1977[1]
Fawns/100 adults	48	64	52	56	34	47	53

[1] On Salmon Lake winter range.

<u>Mortality</u>. Through an analysis of checking station data and the results of state-wide hunter questionnaire returns, I calculated that 167 deer were harvested in 1975 from the herd wintering on the whitetail range at Salmon Lake. The sex-age composition of the harvest was 42 percent bucks, 25 percent does, and 33 percent fawns. Fifteen

dead deer were found during the 1976 winter field season. Five of those deaths were due to predation and/or starvation, and four deer were sacrificed because of trapping injuries. Two roadkills were verified (Table 8). One deer is known to have died in June 1976 from entanglement in vegetation.

Similar analysis of harvest records indicated 100 whitetails were harvested in 1976 from the population wintering at Salmon Lake. The sex-age composition of the harvest was 58 percent bucks, 16 percent does, and 26 percent fawns. Five deaths were verified during the 1977 winter field season. Three of the deaths resulted from collisions with cars. There was one trapping mortality (Table 8).

Reproduction. Six fetuses were collected from roadkills and trap mortalities and measured during the 1976 and 1977 winter field seasons. Conception dates ranged from 23 November through 4 December (Table 9). One fawn was pregnant and one old doe (7½ yrs) had three fetuses.

An attempt to use concentrations of the steroid estriol to determine if does were pregnant was not successful. Pregnant females could not be distinguished from males on the basis of estriol levels in their urine. Table 10 shows results of urine analysis.

Physiological condition. Bone marrow compression values for four deer are listed in Table 11. Adult deer survived the winter in good condition.

A total of 24 blood samples were drawn in 1976 and 1977 from 18 different deer. All but five samples were collected in 1976. Only the five samples in 1977 were analyzed for NEFA and T_3. Average BUN

Table 8. Causes of winter deer mortality.

Date	Age	Sex	Cause
29 Nov 1975	Ad.	M	fell through ice
9 Jan 1976			roadkill
31 Jan 1976	Ad.	M	roadkill
6 Feb 1976	F	M	trapping
28 Feb 1976	Ad.	F	predation
8 Mar 1976	F	F	trapping
13 Mar 1976	Ad.	M	predation
14 Mar 1976	F	M	predation
15 Mar 1976			unknown
23 Mar 1976	F	F	trapping
25 Mar 1976			unknown
26 Mar 1976	Ad.	F	trapping
6 Apr 1976			predation or starvation
6 Apr 1976			predation or starvation
21 Apr 1976	Ad.	F	entangled in fence
1 Feb 1977	Ad.	F	unknown
15 Feb 1977	Ad.	F	roadkill
24 Feb 1977	F	M	trapping
10 Mar 1977	F	F	roadkill
21 Mar 1977	Ad.	F	roadkill

Table 9. Forehead-rump lengths and conception dates.

Forehead-rump lengths (mm)	Conception dates
227[1]	4 Dec
239[2]	4 Dec
247[2]	28 Nov
258[3]	23 Nov

[1] From a fawn.

[2] Average length of twins.

[3] No correction factor.

Table 10. Estriol values for male and pregnant female urine.

Date collected	Species	Sex	Estriol (ng/ml)[1]
4 Feb	mule deer	M	160
5 Feb	mule deer	F	170
5 Feb	whitetail	M	170
6 Feb	mule deer	M	1970
24 Feb	whitetail	F	670

[1] ± 2 ng/ml.

Table 11. Bone marrow compression values.

Date collected	Age	Sex	Percent compression	Cause of death
1 Feb 1977	Ad.	F	5	unknown
15 Feb 1977	Ad.	F	0	roadkill
24 Feb 1977	F	M	11	trapping
21 Mar 1977	Ad.	F	0	roadkill

values for eight fawns and for 11 adults were 9.2 mg% and 13.0 mg%, respectively. NEFA values ranged from 90 to 1,270 uEq/1 and T_3 values ranged from 70.4 to 248 ng/dl. Table 12 lists results of blood analyses.

Table 12. Blood serum analysis data.

Date collected	Sex	Age	Deer number	BUN (mg%)	NEFA (uEq/1)	T_3 (ng/dl)
1-77	M	F	47	13.0		
2-77	M	Ad.	5	8.9		
"	F	Ad.	52	5.5	920	220
"	M	F	53	6.7	880	170
"	M	F	53	8.2	1,270	70.4
3-77	M	F	54	9.0	180	248
"	M	Ad.	36	17.4	90	243
3-76	M	Ad.	11	21.0		
"	M	Ad.	36	11.5		
"		F		9.5		
"	F	Ad.	9	14.7		
"	F	F	37	4.0		
"	F	Ad.	9	15.8		
"	F	Ad.	27	13.4		
"	F	Ad.	38	17.0		
"	F	Ad.	39	16.0		
"	M	Ad.	36	11.2		
"	F	F	30	3.2		
"	F	Ad.	4	81.3		
4-76	F	Ad.	9	18.0		
"	F	Ad.	3	14.2		
"	M	F	5	22.9		
"	F	Ad.	40	3.1		
"	F	F	28	5.0		

<u>Physical measurements</u>. All physical measurements recorded for white-tailed deer checked at the Bonner checking station in 1975 and 1976 are listed in Appendix III. Average values for each sex in each of five age classes are given in Tables 13, 14, and 15 for hog-dressed weights, total lengths, and hind foot lengths, respectively. Old animals included deer 8½ years and older. With one exception, average values for males exceeded average values for females in each age class. The average total length for female fawns exceeded the average total length of male fawns.

Physical measurements were recorded for 30 deer during winter trapping operations. Results are listed in Appendix IV.

Table 13. Hog-dressed weights of whitetails checked at the Bonner checking station, 1975 and 1976.

Age	Hog-dressed weight kg (lb) males avg.	no.	range	females avg.	no.	range
½	30.8 (68)	1		24.9 (55)	5	22.7-29.0 (50-64)
1½	51.3 (113)	13	39.0-61.7 (86-136)		0	
2½	56.2 (124)	1		41.3 (91)	1	
Prime	84.4 (186)	9	64.4-104.8 (142-231)	50.3 (111)	2	44.5-55.8 (98-123)
Old	94.3 (208)	2	88.0-100.2 (194-221)	47.6 (105)	1	

Table 14. Total lengths of whitetails checked at the Bonner checking station, 1975 and 1976.

Age	Total length cm (in) males avg.	no.	range	females avg.	no.	range
½	110.7 (43.5)	9	89.5–119.4 (35.0–47.0)	115.2 (45.5)	18	101.6–128.3 (40.0–50.5)
1½	139.8 (55)	22	114.8–163.8 (45.0–64.5)	128.1 (50.5)	7	113.0–139.7 (44.5–55.0)
2½	153.1 (60.5)	2	144.8–161.3 (57.0–63.5)	135.9 (53.5)	1	
Prime	163.4 (64.5)	12	142.2–180.3 (56.0–71.0)	144.0 (56.5)	10	132.1–171.5 (52.0–67.5)
Old	160.4 (63)	3	152.4–165.1 (60.0–65.0)	152.7 (60.0)	4	146.1–154.9 (57.5–61.0)

Table 15. Hind foot lengths of whitetails checked at Bonner checking station, 1975 and 1976.

Age	Hind foot lengths cm (in) males avg.	no.	range	females avg.	no.	range
½	41 (18.5)	7	39–42 (15.5–16.5)	40 (15.5)	18	36–43 (14.0–17.0)
1½	47 (19.5)	21	43–51 (17.0–20.0)	45 (17.5)	2	
2½	50 (19.5)	2	50–51 (19.5–20.0)	47 (18.5)	1	
Prime	50 (19.5)	10	46–53 (18.0–21.0)	48 (19.0)	7	45–53 (17.5–21.0)
Old	51 (20.0)	4	48–52 (19.0–20.5)	46 (18.0)	3	45–48 (17.5–19.0)

Food Habits

Volumetric rumen analyses showed that grasses and Oregon grape were the primary food items during the winter field seasons. Penstemon sp. and Equisetum sp. were next in order of importance, followed by Douglas-fir. Grasses, Douglas-fir, and Oregon grape were present in all 12 rumen samples. The total volume of each food item from all samples is presented in Table 16.

Analyses of browse transect results indicated that chokecherry received the highest degree of utilization with 42.9 percent of the leaders of current annual growth (CAG) browsed and 41.8 percent of the leaders of previous years growth (PYG) browsed. Rocky Mountain maple, dogwood, serviceberry, rose, and willow followed in order by degree of utilization. The use of ceanothus is disregarded due to the small sample size. The highest percentage of utilization on leaders of CAG occurred on Rocky Mountain maple. The highest percentage of utilization on leaders of PYG occurred on chokecherry. Results are summarized in Table 17.

The number of bites of each shrub species within 588 2 x 2 meter (6.6 x 6.6 ft) plots indicated that deer took more bites of chokecherry than any of the other 11 species. Fewer bites were taken of serviceberry, followed in order by rose, Rocky Mountain maple, spirea, and Oregon grape. Results are summarized in Table 18.

Extent of the Winter Range

The winter range used extensively in mild winters extended south along the shores of Salmon Lake and along the Clearwater River

Table 16. Total volume of each food item from 12 rumen samples.

Plant species	Volume (cc)	Percent	No. of samples in which present
Grasses	346.6	32.10	12
Berberis repens	260.8	24.20	12
Penstemon sp.	81.1	7.50	8
Equisetum sp.	76.9	7.10	1
Pseudotsuga menziesii	67.7	6.30	12
Amelanchier alnifolia	62.2	5.80	9
Medicago sp.	57.6	5.30	6
Heuchera parviflora	40.1	3.70	9
Spirea betuliflora	27.7	2.60	9
Pinus ponderosa	13.2	1.20	8
Arctostaphylos uva-ursi	11.7	1.10	4
Ceanothus velutinus	7.4	0.70	5
Prunus virginiana	2.4	0.20	5
Allectoria sp.	0.4	0.04	1
Salix sp.	0.2	0.02	1
Vaccinium globulare	0.2	0.02	1
Symphoricarpos albus	0.1	0.01	1
Ranunculus sp.	0.1	0.01	1
Juniperus horizontalis	trace	trace	1
Unidentified material	23.1	2.10	2
	1,079.0	100.00	

Table 17. Browse utilization based on analysis of browse transect data.

Plant species	No. of shrubs	Leaders: Total no. CAG	PYG	both	No. browsed CAG	PYG	both	Percent browsed CAG	PYG	both
Prunus virginiana	26	196	91	287	84	38	122	42.9	41.8	42.5
Acer glabrum	28	217	75	292	98	2	100	45.2	2.7	34.2
Cornus sp.	17	194	21	215	61	2	63	31.4	9.5	29.3
Amelanchier alnifolia	207	3,006	1,035	4,041	812	87	899	27.0	8.4	22.2
Ceanothus velutinus	3	14	3	17	3	0	3	21.4	0.0	17.6
Rosa spp.	78	549	230	779	88	1	89	16.0	0.4	11.4
Salix sp.	12	155	43	198	14	3	17	9.0	7.0	8.6
Pseudotsuga menziesii	57	10,022	4,350	14,372	21	14	35	0.2	0.3	0.2
Juniperus horizontalis	1	525	181	706	0	1	1	0.0	0.6	0.1

Table 18. Browse utilization based on bites/species in 2 x 2 meter (6.6 x 6.6 ft) plots.

Plant species	No. of bites	Percent of bites
Prunus virginiana	831	44.1
Amelanchier alnifolia	279	14.8
Rosa sp.	208	11.0
Acer glabrum	184	9.8
Spirea betuliflora	153	8.1
Berberis repens	139	7.4
Pseudotsuga menziesii	41	2.2
Salix sp.	37	2.0
Symphoricarpos albus	12	0.6
Cornus sp.	0	0.0
Ceanothus velutinus	0	0.0
Pinus ponderosa	0	0.0
	1,884	100.0

Table 17. Browse utilization based on analysis of browse transect data.

Plant species	No. of shrubs	Leaders								
		Total no.			No. browsed			Percent browsed		
		CAG	PYG	both	CAG	PYG	both	CAG	PYG	both
Prunus virginiana	26	196	91	287	84	38	122	42.9	41.8	42.5
Acer glabrum	28	217	75	292	98	2	100	45.2	2.7	34.2
Cornus sp.	17	194	21	215	61	2	63	31.4	9.5	29.3
Amelanchier alnifolia	207	3,006	1,035	4,041	812	87	899	27.0	8.4	22.2
Ceanothus velutinus	3	14	3	17	3	0	3	21.4	0.0	17.6
Rosa spp.	78	549	230	779	88	1	89	16.0	0.4	11.4
Salix sp.	12	155	43	198	14	3	17	9.0	7.0	8.6
Pseudotsuga menziesii	57	10,022	4,350	14,372	21	14	35	0.2	0.3	0.2
Juniperus horizontalis	1	525	181	706	0	1	1	0.0	0.6	0.1

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Prunus virginiana	831	44.1
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Spirea betuliflora	153	8.1
Berberis repens	139	7.4
Pseudotsuga menziesii	41	2.2
Salix sp.	37	2.0
Symphoricarpos albus	12	0.6
Cornus sp.	0	0.0
Ceanothus velutinus	0	0.0
Pinus ponderosa	0	0.0
	1,884	100.0

from 0.8 kilometers (0.5 mi) north of Fish Creek to Blanchard Lake. The area was about 9.66 kilometers (6 mi) long and varied in width from 0.8 to 3.5 kilometers (0.5 to 2.2 mi). Fig. 5 outlines the area which totaled 19.06 square kilometers (7.36 sq mi).

A number of whitetails wintered north of Salmon Lake and south of Drew Creek (J. Haveman, pers. comm.) and some whitetails probably moved between this area and the area I have defined as whitetail winter range. However, the intervening Salmon Lake Hills were used predominately by mule deer. Mule deer used portions of the whitetail winter range east of State Highway 209.

Use of the Winter Range

Seventeen topo-cover types (T.C.T.) defined by topography and relative overstory density were identified on the study area. The name, number, and area of each topo-cover type was listed in Table 4. Deer were observed in 12 of these topo-cover types during systematic searches of the study area (Table 19). The greatest deer numbers occurred on south-facing and east-facing slopes with intermediate overstory cover (T.C.T.s 6 and 9, respectively). The number of deer sighted per mile of topo-cover type searched was very low (less than 1/mi) on east-facing slopes, lowlands, and kettle-dome lands with dense overstory cover (T.C.T.s 8, 13, and 16, respectively). Few deer were seen on west-facing slopes and lowlands with open overstories (T.C.T.s 12 and 15, respectively) as well as on all ridge-top topo-cover types. Intermediate numbers of deer occurred on north-facing slopes with dense overstories (T.C.T. 4), south-facing slopes with dense overstories (T.C.T. 5), south-facing slopes with open overstories (T.C.T. 7), west-

Fig. 5. Extent of Salmon Lake whitetail winter range used extensively in mild winters.

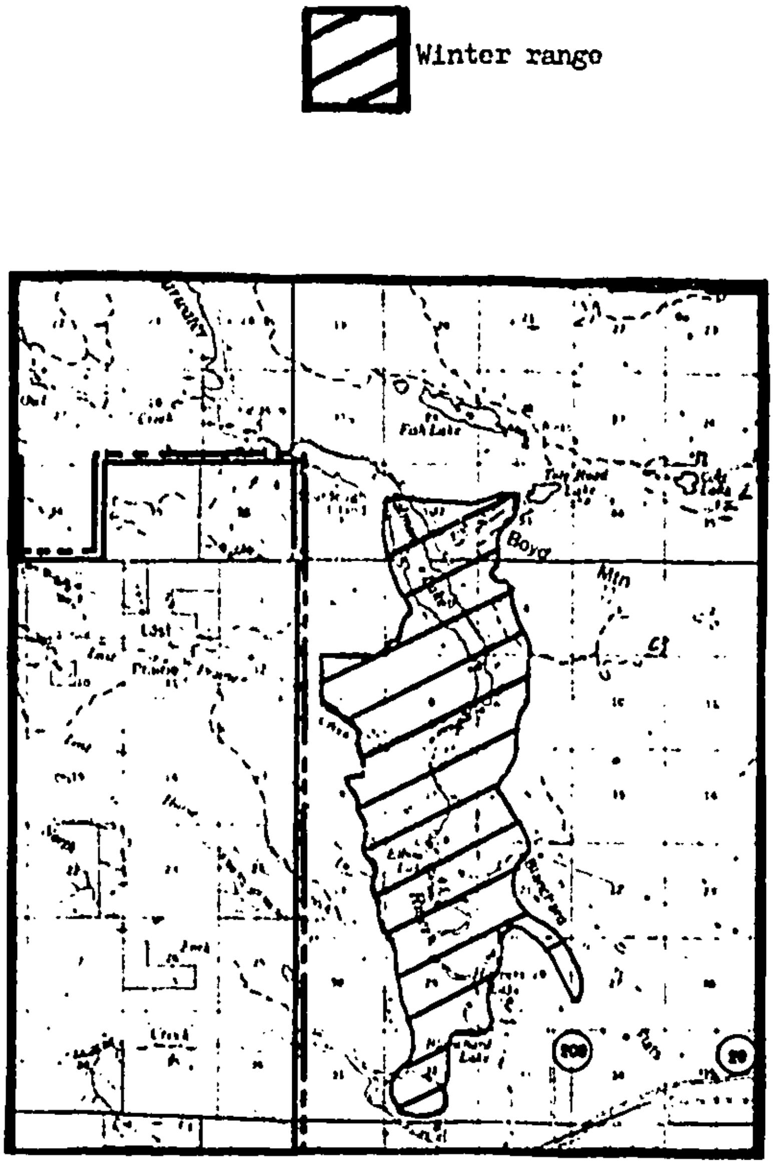


Table 19. Comparison of topo-cover type use.

Topo-cover type topography	overstory	no.	Deer/mi searched	Browse transect no.	% util.	Bites/plot
Ridge top	dense	1	0.00			
"	intermed.	2	0.82			
"	open	3	0.00			
North-facing	dense	4	1.78	7 9	8.5 35.5	4.3
South-facing	dense	5	1.09	5	21.8	4.6
"	intermed.	6	10.58	4 3	40.7 57.9	5.4
"	open	7	2.16			
East-facing	dense	8	0.45	2	21.7	1.0
"	intermed.	9	8.65	6	24.4	
West-facing	dense	10	2.13	8	19.9	1.9
"	intermed.	11	3.16	10	21.0	4.5
"	open	12	0.00	1	31.1	
Lowland	dense	13	0.82			
"	intermed.	14	2.76			0.8
"	open	15	0.00			
Kettle-dome	dense	16	0.00			
"	intermed.	17	3.48	11	16.4	1.8
Water	-					

facing slopes with dense overstories (T.C.T. 10) and intermediate overstories (T.C.T. 11), lowlands with intermediate overstories (T.C.T. 14), and kettle-dome lands with intermediate overstories (T.C.T. 17).

Utilization of shrubs on 11 browse transects were also used to indicate the intensity of use that various topo-cover types received. The percentage of all the leaders of CAG and PYG of serviceberry, chokecherry, Rocky Mountain maple, rose, dogwood, and willow that were utilized by deer was determined for nine topo-cover types. Shrubs on south-facing slopes with intermediate overstory cover (T.C.T. 6) and north-facing slopes with dense overstory cover (T.C.T. 4) were utilized most extensively (Table 19).

Data from back-tracking plots and transect plots were used to determine the average number of bites per 2 x 2 meter (6.6 x 6.6 ft) plot in eight topo-cover types. Results indicated that deer occurred most often on south-facing slopes with intermediate and dense overstories, T.C.T. 6 and 5, respectively (Table 19).

The methods used to indicate which topo-cover types were used most by deer did not provide results that are in total agreement. However, it appears T.C.T. 6 had a high level of use and T.C.T. 8 had a low level of use. Impressions developed from observation of deer trails and tracks and incidental sightings of deer combined with the results presented above lead me to believe that T.C.T.s 4 and 6 had high levels of use and T.C.T.s 8 and 17 had low levels of use.

Vegetal characteristics, snow depths, and the number of coyote tracks and elk tracks in those topo-cover types were compared. Vegetation characteristics were derived from data recorded at the 2 x 2 meter (6.6 x 6.6 ft) plots while back-tracking deer. Forty-three, 61 and 53 plots were studied in T.C.T.s 4, 8, and 17, respectively. However, the absence of snow in T.C.T. 6 made back-tracking impossible, so vegetation characteristics were not available for this topo-cover type.

Grasses and/or forbs were present in only 26 percent of the plots in T.C.T. 4 while they were present in 52 percent and 45 percent of the plots in T.C.T.s 8 and 17, respectively. Oregon grape was present in a greater percentage of plots in T.C.T.s 8 and 17 than in T.C.T. 4. Serviceberry and/or chokecherry were present in 14 percent of the plots in T.C.T. 4 and present in 6.6 percent and 13.2 percent of the plots in T.C.T.s 8 and 17, respectively. Unpreferred shrub species, rose and spirea, were present in 39.5 percent of the plots in T.C.T. 4, 13.1 percent of the plots in T.C.T. 8, and 15.1 percent of the plots in T.C.T. 17.

Average overstory density in T.C.T. 4 was 66 percent, and in T.C.T.s 8 and 17 average overstory density was 55.7 percent and 49 percent, respectively. Aggregate shrub density in 2 x 2 meter (6.6 x 6.6 ft) plots was 7.23 percent in T.C.T. 4 and 5.92 percent and 6.45 percent in T.C.T.s 8 and 17, respectively.

Snow course data for 11 topo-cover types are shown in Table 20. Snow depths in T.C.T.s 4 and 6 were intermediate to low in relation to depths in other topo-cover types on the study area. Snow depths in T.C.T. 17 were high in relation to depths in other topo-cover types.

Deer use in T.C.T.s 8 and 17 occurred on more gentle slopes than in T.C.T. 4. Use in T.C.T. 4 occurred primarily on the northeastern aspects. In T.C.T. 8, use occurred primarily on the eastern aspects. Use was rather evenly distributed on all aspects of T.C.T. 17.

Table 20. Snow depths in topo-cover types, 1977.[1]

Topo-cover type			Depth cm (in)					
topography	overstory	number	16-18 Jan	28 Jan-1 Feb	11-12 Feb	25-26 Feb	11-12 Mar	23-24 Mar
Lowland	open	15	47(19)	40(16)	34(13)	26(10)	24(9)	21(8)
Kettle-dome	intermed.	17	40(16)	30(12)	25(10)	20(8)	17(7)	13(5)
West-facing	intermed.	11	52(20)	29(11)	23(9)	16(6)	14(6)	13(5)
East facing	intermed.	9	48(19)	25(10)	20(8)	19(7)	7(3)	3(1)
South-facing	dense	5	38(15)	23(9)	18(7)	13(5)	10(4)	7(3)
West-facing	dense	10	45(18)	26(10)	17(7)	8(3)	6(2)	4(2)
North-facing	dense	4	45(18)	23(9)	17(7)	9(4)	6(2)	3(1)
South-facing	intermed.	6	30(12)	24(9)	20(8)	9(4)	5(2)	1(0)
Lowland	intermed.	14	24(9)	19(7)	9(4)	5(2)	5(2)	4(2)
West-facing	open	12	21(8)	15(6)	7(3)	1(0)	0(0)	0(0)
South-facing	open	7	23(9)	13(5)	8(3)	0(0)	0(0)	0(0)

[1]Bi-monthly snow depths based on 10 measurements in topo-cover types 5 and 6, other depths based on five measurements.

Only three sets of elk tracks were encountered while back-tracking deer in T.C.T. 4. Six sets were observed in T.C.T. 8, and 10 were observed in T.C.T. 17.

The Chi-square test was used to test for a significant difference in the slopes and aspects of the back-tracking and the transect plots in each topo-cover type studied. No significant difference was observed between these plots, except in T.C.T.s 11 and 8. In T.C.T. 11, slopes in back-tracking plots were generally less than 30 percent, while slopes in transect plots were more evenly distributed between 0 and 90 percent. In T.C.T. 8, there were significantly more south-eastern aspects in back-tracking plots than in transect plots.

Aggregate shrub densities in back-tracking plots were less than in transect plots except in T.C.T. 10 where shrub densities were very similar. Overstory densities were greater in dense cover than in intermediate cover, as expected. Differences between average overstory density in back-tracking and transect plots in each topo-cover type ranged from 2.4 to 12.2 percent but confidence intervals overlapped.

Summer Distribution

Nine deer were radio-collared during the 1976 winter field season. One radio-collar failed during the spring migration and one radio-collar was returned to the Department of Fish and Game by a local resident who had found the collar on a dead deer during June 1976. Therefore, summering locations for seven deer were determined on six aerial radio-tracking flights between 13 May 1976 and 28 September 1976.

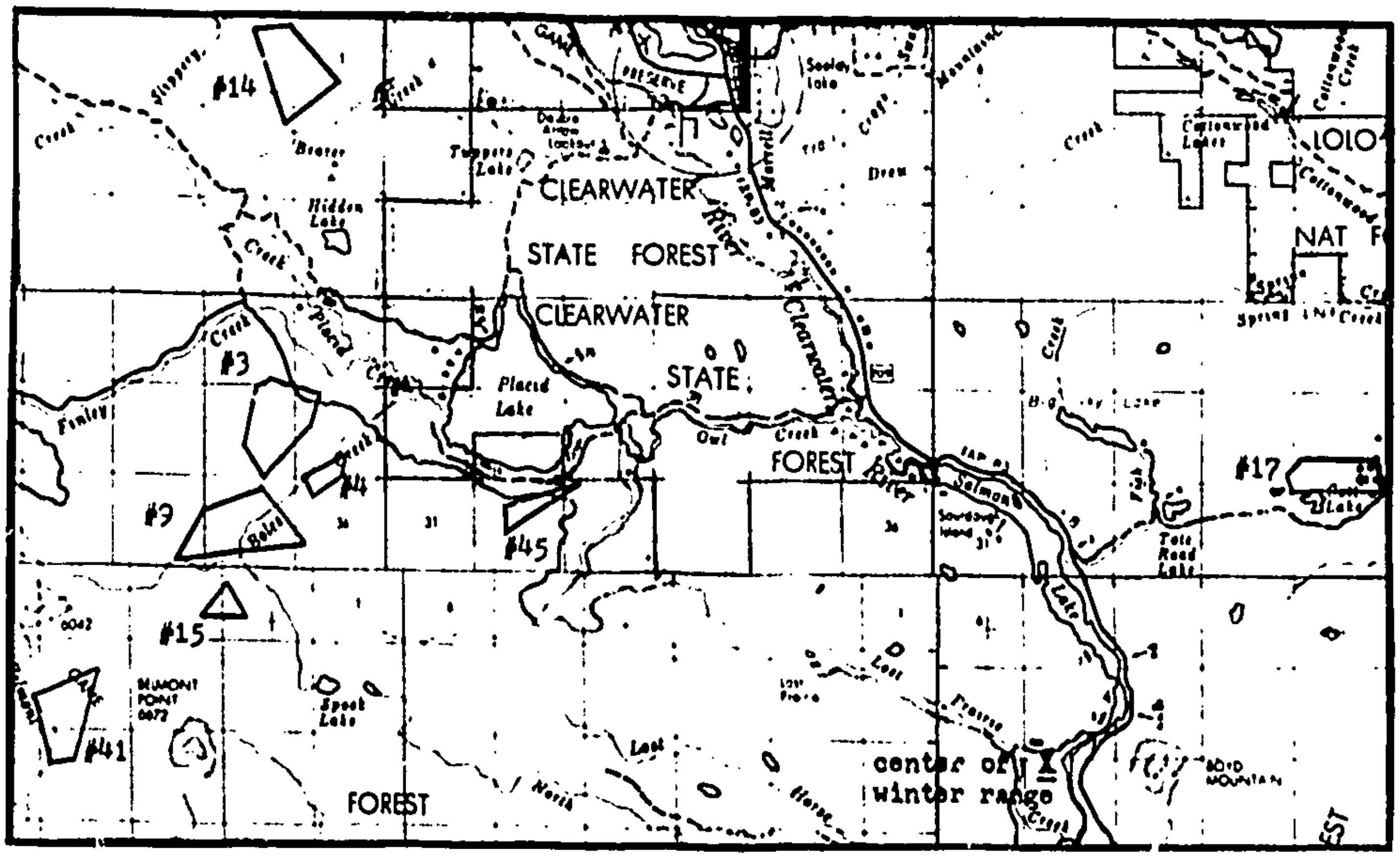
The radio-collar retrieved from the dead deer in June 1976 was placed on another deer during the 1977 winter field season. Trapping success was very poor, so two other collars retrieved in 1977 were not placed on other deer. Another radio-collar failed in 1977. Therefore, five radio-collars were operating on deer during the summer of 1977. The summering locations for five deer were determined from six aerial radio-tracking flights between 28 April 1977 and 23 September 1977.

Four of the radio-collars remained functional on the same deer for both summers. In every case, radio-tracking showed each deer used the same area in 1976 and 1977. Fig. 6 shows the summering locations of the eight radio-collared deer. Distances between the center of the winter range and the summering areas ranged from 6.44 kilometers (4 mi) to 18.52 kilometers (11.5 mi). The average distance was 13.99 kilometers (8.7 mi). Each deer seemed to summer on less than 2.59 square kilometers (1 sq mi).

During the summer of 1976, 779 kilometers (424 mi) of roads in the Clearwater River drainage were systematically travelled. Only 14 whitetails were seen. They included two radio-collared deer whose locations were previously known and one plastic-collared deer. Color design had to be identified for each collared deer since whitetails wintering in the Swan Valley were being trapped and collared too. Those deer had identical color patterns but different designs and were known to be summering in the Clearwater River drainage (J. Mundinger, pers. comm.).

Personnel from the Department of Fish and Game, the U.S. Forest Service, and Burlington Northern provided several locations of collared deer. However, color patterns were not identified so I could not determine if the deer were from the Salmon Lake or Swan Valley winter range.

Fig. 6. Summering locations of eight radio-collared deer.[1]



[1]Outlines of summering locations for deer no.'s 3, 14, 17, and 41 based on 2 years of data.

Two of the 42 collared deer that I assumed to be alive were harvested during the 1976 hunting season, one near Placid Lake and the other near the Double Arrow Ranch.

CHAPTER V

DISCUSSION

Population Characteristics

Total numbers. Censusing wildlife populations is very difficult and results must be viewed with some skepticism. Robinette et al. (1974) stated that the Kelker belt transect was one of the better methods available. However, Robinette's opinion was based on the results of tests run in open grassland and shrubland. The rough terrain on the Salmon Lake study area prevented accurate measurement of transect lengths and severely obstructed the view of the observers. Gates (1968) listed the following five prerequisites for using line transect methods for estimating population densities.

1. Animals are uniformly and evenly distributed.
2. Animals flush independently.
3. Animals are not counted more than once.
4. Animals are seen before they move.
5. All animals react the same.

None of the prerequisites were upheld on the study area.

Estimates from the transect method were derived by summing estimates for two areas stratified by visibility. This method was described by Robinette et al. (1974).

The difference between 1976 and 1977 estimates, 474 deer and 342 deer, respectively, may have been due to several factors. Only 7.53 kilometers (4.68 mi) of transects were run in 1976. In 1977, 22.04 kilometers (13.69 mi) of transects were run. The greater effort in 1977 may have provided a more representative sample of deer numbers. Different observers helped me make the counts both years. Their abilities to see deer and accurately estimate distances may have affected results. The difference may have resulted from the inability to meet all the requirements necessary for accurate censusing. The possibility that differences in winter weather in 1976 and 1977 may have affected deer concentrations should also be considered.

Investigators using the Lincoln-Peterson estimator assume that marks are not lost, marked animals mix at random with unmarked animals after trapping, there is no death in the population, there is no immigration or emigration, and all positions in the habitat are equally trappable (Emmel 1976). Some collars were lost by marked deer, but an adjustment was made for this loss of marks.

The Lincoln-Peterson estimate of 354 deer was applied to only 11.60 square kilometers (4.48 sq mi) at the northern end of the white-tailed deer winter range because this was the area in which I felt the marked deer were capable of mixing with the unmarked deer. I doubt that all deer moved extensively throughout the entire winter range. Immigration and emigration seemed probable, too. Therefore, at least some of the assumptions of the Lincoln-Peterson estimate were violated.

The Kelker estimate of 342 to 474 deer for 19.06 square kilometers (7.36 sq mi) and the Lincoln-Peterson estimate for 11.60 square kilometers (4.48 sq mi) were in fair agreement considering that the assumptions of both methods were violated. Although the Lincoln-Peterson estimate could be extrapolated to 633 deer for the entire winter range, deer concentrations seemed greater in the northern portion of the winter range, and the deer appeared to move southward onto the flats along the river below Elbow Lake in late winter. The 385 deer on the northern portion of the winter range spread out, southward, into portions of the winter range with lower densities. Therefore, my estimate for the 19.06 square kilometers (7.36 sq mi) of whitetail winter range based solely on the Lincoln-Peterson estimate would be between 385 and 633 deer.

When population estimates from both methods are taken into consideration, I am inclined to place the deer population on the winter range at 400 to 550 deer. This is equivalent to between 21 and 29 deer/square kilometer (54 to 75/sq mi). These estimates do not include the white-tailed deer wintering north of Salmon Lake and south of Drew Creek.

The Lincoln-Peterson estimate for the northern portion of the winter range with high deer concentrations was 33 deer/square kilometer (86/sq mi), significantly lower than the 50 deer/square kilometer (130/sq mi) reported in 1956 (Hartkorn and Rognrud 1956). Although the 1956 estimate may have been based on less precise data, it seems that deer numbers have decreased on the winter range since 1956.

Sex ratio. Many hunters pass up does in hopes of finding a buck (F. Hartkorn, pers. comm.). This can cause sex ratios based on harvest data to indicate a disproportionately high percentage of males in the population. However, adult bucks are less vulnerable than does during either-sex seasons, according to a study conducted in a forested enclosure in northern Michigan (VanEtten et al. 1965). An overestimation of the proportion of males in the population can result. Therefore, sex ratio figures based on harvest data are speculative. Greater effort in the field in December is necessary to determine the sex ratio of wintering deer at Salmon Lake. Man-hours could be greatly increased by using undergraduate students enrolled in wildlife courses at the University of Montana.

Age ratio. McCarthy et al. (1974) rated survival as follows: less than 31 fawns:100 adults is very poor, 31-47 fawns:100 adults is poor, 48-65 fawns:100 adults is good, 66-84 fawns:100 adults is very good, and more than 84 fawns:100 adults is excellent. Based on these ratios, fawn production and/or survival was good for deer wintering at Salmon Lake.

Mortality. The harvest figures for deer wintering at Salmon Lake (167 in 1975 and 100 in 1976) were speculative. The calculations assumed that the distribution of deer harvested in hunting district 283 was identical to the distribution of deer harvested in hunting district 283 and checked at the Bonner checking station. The assumption may not have been valid since hunters using hunting district 283 may have been living in the area or may have come from the north, south, or east and would not have passed through the Bonner checking station. However, it is clear that the harvest in 1975 was greater than the harvest in 1976. Winter losses followed this pattern, too.

O'Roke and Hamerstrom (1948) found that 33 percent of a herd could be harvested each year if sexes were harvested in equal numbers and if deer were on good range. Assuming that the harvest estimates and the population estimates were accurate, between 18 and 42 percent of the deer using the Salmon Lake winter range were harvested each year. These percentages may be high since the number of whitetails wintering north of Salmon Lake and south of Drew Creek was not known; however, the crippling losses that can be as high as 10 to 15 percent of the legal kill (VanEtten et al. 1965) may adjust for this omission to some extent. About 5 percent of the collared deer wintering at Salmon Lake were harvested, assuming some deer lost their collars. Based on these percentages, I feel that less than one-third of the population was harvested in 1975 and 1976.

Winter mortality was low during the 1976 and 1977 field seasons. The winter of 1975 was very severe. The State game warden for the Salmon Lake area, Jay Haveman, said deer were standing along State Highway 209 that winter. As many as three roadkills occurred some days along Salmon Lake. A dead deer survey in the spring of 1975 produced 60 dead deer on 1.94 square kilometers (0.75 sq mi) (Janson 1975). Losses are directly related to winter severity, indicating the winter range is not presently capable of supporting the resident population during severe winters.

The number of poaching losses were hard to determine. No signs of poaching were observed on the study area. However, poaching does occur, primarily along State Highway 209 at Salmon Lake (J. Haveman, pers. comm.).

Fawns were most susceptible to trapping injuries that necessitated sacrificing of the deer. The losses are difficult to justify and attempts should be made to eliminate them if further trapping is necessary.

The number of coyote tracks and verified coyote kills indicated coyote predation was not a significant mortality factor during the last two winters. However, roadkills were quickly scavenged; and deer legs were occasionally found with no carcass in the vicinity, indicating coyote activity.

Murie (1945) felt that coyotes fed on species that were abundant and easy to catch in numbers sufficient for survival. The opportunistic coyote (Ozoga and Harger 1966) may prey heavily on whitetails if winter stress makes them susceptible. The role of the coyote may be significant during severe winters at Salmon Lake.

The number of deer drowning each winter was hard to estimate. Tracks indicated that deer crossed the lake all winter. One adult buck was found frozen in the ice at the southern end of Salmon Lake. On several mornings I observed holes in the ice in the same area. The owner of several cottages along Salmon Lake informed me that he had seen deer fall through the ice and drown.

Roadkills were often picked up by coyote hunters and trappers and used as bait. Therefore, known losses were probably less than the total losses due to collisions with cars.

<u>Reproduction</u>. Cheatum and Morton (1946) found the peak of breeding in northern New York occurred from 10 to 16 November while it peaked from 17 to 23 November in southern New York. Data from the Salmon Lake area suggested breeding peaked at a later date than in New York. However, my sample size was very small and the correction factor added to the forehead-rump values may have been inappropriate.

Estriol is not a sensitive indicator of pregnancy in deer. If analysis of some other component of deer urine could be used to differentiate males and females and indicate pregnancy in females, then tests on urine reconcentrated from snow-urine mixtures could be used to determine sex ratios and reproductive rates. Of course, deer concentrations would have to be high enough to provide an adequate number of urine samples, and the cost of urine analysis would have to be minimal if the technique was to be useful.

Physiological condition. O'Gara (1968) analyzed 113 pronghorn (Antilocapra americana) bone marrows that did not compress. Fat content ranged from 79.4 to 98.2 percent. Greer (1968) analyzed 291 marrows from elk and indicated marrow fat content exceeded 70 percent if the bone marrow compressed no more than 5 percent. Twenty to 40 percent compression indicated severe malnutrition. However, bone marrow analysis was not sensitive to early stages of fat reserve mobilization (Riney 1955), so low bone marrow compression values did not indicate that deer were in excellent condition at Salmon Lake.

No bone marrow samples from the study area indicated severe malnutrition. The highest compression value, 11 percent, was for the only sample from a fawn. This is understandable since small deer enter the winter with lower fat reserves than large deer (Moen 1973).

Analyses of deer blood have been conducted for many years. Values for various parameters were reported by Bandy et al. (1957) for black-tailed deer and by Wilbur (1958) for white-tailed deer. In the early 1970's researchers felt blood analysis could be a potential means of detecting nutritional status of deer (Seal et al. 1972). LeResche et al. (1974) reviewed the literature on blood chemistry in moose and other Cervidae and came to a similar conclusion. By 1977, Seal felt enough data had been collected and analyzed to enable researchers to determine the nutritional, reproductive, and disease status of deer through blood analysis (Seal 1977). While numerous parameters must be analyzed to allow proper interpretation of condition, blood urea nitrogen (BUN), non-esterified fatty acids (NEFA), mean corpuscular hemoglobin concentration (MCHC), and triiodothyronine (T_3) are some of the key parameters.

BUN values were lower for deer with lower levels of protein in their diets (Seal et al. 1972); but fawns on a poor diet for a prolonged period had BUN values higher than those on a sufficient diet because starvation caused protein catabolism (Nagy et al. 1974).

Seal (1977) found NEFA values were higher for deer on low energy diets. Nagy et al. (1974) produced similar results with deer on poor diets. However, these values varied in some domestic animals in relation to time since feeding, starvation, carbohydrate deficiency, and hormone balance (Carroll 1963). Bowden (1971) found handling stress elevated NEFA levels in sheep. The two blood samples drawn from deer number 53 supported Bowden's findings. The second sample was drawn about 30 minutes after a pinched nerve necessitated sacrificing the fawn.

The need to monitor other parameters sensitive to dietary protein and energy intake is obvious. Seal (1977) found that MCHC was higher for deer on a low protein diet. T_3 was lower for deer on a low energy diet. These parameters were just two of the several parameters they suggested biologists monitor.

The average BUN concentration of 13 mg% for adult white-tailed deer at Salmon Lake exceeded the value of 5.5 mg% for adult mule deer in the Rattlesnake Creek area (Taber 1959) near Missoula. The difference may indicate the whitetails received more protein in their diets, or the difference may be due, in part, to different techniques used to determine BUN values. Sufficient sample sizes may be obtained on the study area with intensive trapping efforts during a hard winter.

Comparison of the BUN, NEFA and T_3 values from Salmon Lake deer with the values for deer in the upper Midwest (Seal 1977) indicates that the Salmon Lake deer are on a very low energy diet. However, this analysis is not appropriate. Accurate analyses of values for the various parameters will require baseline data from a group of deer living under similar conditions in or near western Montana whose physiological condition is known (Seal, pers. comm.).

Food Habits

Results from rumen analysis can be misleading due to differences in digestibility of woody twigs and herbage in deer rumens (Short and Reagor 1970). Differential digestibility may explain why Douglas-fir seemed to be an important food item. Also, the small sample size was misleading. For example, Equisetum sp. was present in only one rumen sample, but its volume was great enough to overrate its preference. Despite these shortcomings, low lying grasses and forbs seemed to be preferred by the deer. Deer wintering in deeper snow in the Swan Valley 61 kilometers (38 mi) north fed primarily on shrubs (Hildebrand 1971).

The utilization of each of 12 shrub species in 2 x 2 meter (6.6 x 6.6 ft) plots indicated Oregon grape was only sixth on the list of species used. This was misleading because the shrub grew close to the ground and it was difficult to detect all the bites taken. If the entire shoot was consumed, the remaining stub may have been hidden by grass or snow.

Since densities for all shrub species were not identical and since the species were not evenly distributed, the species were not encountered with the same frequency. As a result, preferences for some species may be hidden by availability of other species.

Even fewer shrub species were sampled in browse transects. Use was based on the percentage of leaders browsed. The value of chokecherry was shown in part by the fact that 41.8 percent of its 2-year old leaders were consumed. However, even this seemingly clear-cut preference was obscured by the fact that chokecherry occurred primarily in one of the most heavily used topo-cover types where scree was very common and the amount of vegetative ground cover was relatively low.

When general impressions are added to the results of these three methods, I feel grasses, forbs, and Oregon grape are preferred when available. Preference for serviceberry, chokecherry, and Rocky Mountain maple are highest among the common shrub species. Dogwood and willow are preferred too, but they were not widely available on the study area. Ponderosa pine, Douglas-fir, snowberry, and spirea are not preferred.

Preferences are further indicated by the areas used by the deer. Deer concentrated on the steep south-facing slope for a large part of the winter. Snow disappeared from this area first, exposing low lying vegetation. Serviceberry shrubs in snow at the bottom of the slope were not utilized at all in 1977 (Eddleman 1977). At the end of the winter in 1976 and 1977, deer began to congregate on the level, open grasslands along the Clearwater River and State Highway 209 which were free of snow at the time.

Use of the Winter Range

The number of miles walked in systematic searches for deer were not evenly distributed among the topo-cover types so that some types were not sufficiently sampled. Also, more deer were sighted in topo-cover types with intermediate cover than in topo-cover types with dense cover, indicating deer were more easily seen in types with intermediate overstory cover. Time of day may have influenced results, too, since not all searches were made during late afternoon.

Determination of topo-cover type use through analyses of the percentage of shrub leaders browsed or of the average number of bites on shrubs in 2 x 2 meter (6.6 x 6.6 ft) plots assumed that density of shrubs was similar in all cover types. This was not the case. High use of shrubs or plots requires few deer in a topo-cover type with low shrub density but may require many deer in a topo-cover type with high shrub density.

Despite the shortcomings, I feel the results of these methods indicated areas receiving high and low use. The methods did not allow ranking of areas that seemed to get intermediate use.

Comparison of vegetal characteristics in T.C.T.s 4, 8, and 17 did not provide any indications concerning why certain topo-cover types received higher use. The percentage of plots with grasses and forbs was lower in T.C.T. 4 than in T.C.T.s 8 and 17. The percentage of plots containing preferred shrub species was similar for all three topo-cover types. The percent occurrence of unpreferred shrub species in plots was greater in the topo-cover type with high use than in the types with low use.

Slopes were greater in the topo-cover types with high use than in the topo-cover types with low use. In the Adirondacks of New York white-tailed deer preferred steep south-facing slopes rather than lowlands because snow accumulated to a lesser degree and persisted for a shorter period of time on steep south-facing slopes (Dickinson 1976). Drolet (1976) found that whitetails used areas with dense overstory cover when snow depths were capable of restricting movement. Snow depths were moderate and deer trails were numerous in T.C.T.s 4 and 6 while deer trails were less numerous in T.C.T.s 8 and 17 and snow depths were greater in T.C.T. 17. Ease of movement may be a factor governing habitat use on the Salmon Lake winter range.

I doubt that deer use steep slope areas as a means of predator avoidance since it seems likely that coyotes could force deer downslope to deep snow if they attacked from above. Two confirmed coyote kills occurred in the deeper snow at the bottom of the steep south-facing slope. The deer, an old buck and a fawn, may have been too weak to escape upslope.

My general impression from observation of deer and deer signs on the study area was that the deer made extensive use of all portions of Section 8. They also used the steep south-facing slope in the southeastern quarter of Section 7, and the gentle, generally west-facing slopes in the northeastern quarter of Section 17 and the southwestern quarter of Section 16. The portions of Section 17 south of the power line and west of State Highway 209 received less use. These high use areas all had ridges or slopes that were the first to be free of snow, increasing the availability of grasses, forbs, and shrubs. Snow-free areas also allowed deer to conserve metabolic energy normally burned in moving through snow (Moen and Evans 1971). In addition, these areas provided sites for "sunning" while dense overstory cover was nearby. The variability in cover can be used by deer when responding to a "critical thermal environment" to sustain a constant temperature (Moen 1973).

This study did not indicate that deer selected areas with certain slopes, aspects, or overstory densities within each topo-cover type. The difference in slope and aspect of transect and backtracking plots in T.C.T.s 11 and 8, respectively, was significant. However, sample sizes were small and degrees of freedom in the Chi square tests were three or less. I feel that deer do not select for or against various slopes or aspects when travelling each topo-cover type. Deer do not appear to select areas with specific overstory densities within topo-cover types, either.

Deer tend to avoid shrub cover when travelling through topo-cover types. This may be due to the mild weather which reduced the stress on deer, so they could spend less time feeding and select preferred grasses and forbs. However, poor tracking conditions often forced me to abandon individual tracks and follow deer trails. As a result, I may have been tracking deer that were intent on passing through the area and were not feeding.

Summer Distribution

The summering locations of the radio-collared deer indicated that most deer wintering at Salmon Lake move northwest for the summer. Other whitetail wintering ranges are found east, south, and west of the Salmon Lake wintering range. This supports the idea that the whitetails migrate from the north for the winter. Based on the locations of radio-collared deer and the locations of other winter ranges, I feel that the summer range of whitetails wintering at Salmon Lake is bounded on the west by Game Ridge, Belmont Point, Boles Point, and the Flathead Indian Reservatior boundary. Northern boundaries can be defined as Deer Creek and the top of Blind Canyon Creek. The North Fork Cottonwood Creek and the Missoula County line provide eastern limits to the summer range, and State Highway 200 bounds the summer range on the south.

Some whitetails wintering in the Swan Valley were known to use this summer range (J. Mundinger, pers. comm.). Radio-collared deer wintering in the Swan Valley were located in the Placid Creek drainage and near Placid Lake. Two radio-collared deer were located near Salmon Lake on 15 December 1976, but they returned to the Swan Valley winter range.

CHAPTER VI

MANAGEMENT RECOMMENDATIONS

The number of deer and the resources they use are not properly balanced on the Salmon Lake winter range. Occasional high winter mortality supports this conclusion. Solutions fall into two categories, manipulate deer numbers or manipulate resources on the winter range.

Manipulating deer numbers usually means extending doe seasons or general seasons or using special seasons on winter ranges. Generally, the public disapproves of these measures. Reducing deer numbers when the numbers of hunters are increasing and hunter success is decreasing is not popular. Diethylstilbesterol (DES) can be used to reduce reproductive performance (Harder and Peterle 1974, Matschke 1977) but the methods available for administration of the drug are not practical with the Salmon Lake population. Local residents and hunters would not accept this solution, either. However, more restrictive seasons are not recommended and either-sex seasons should be encouraged.

Manipulation of resources on the winter range is the other alternative. Potential action includes eliminating human disturbance, reducing coyote numbers, reducing livestock use, and logging or burning areas.

Eliminating human disturbance by refusing access to cottages in the winter, prohibiting snowmobiling, and closing dirt roads is very difficult and involves facing negative public pressure, especially from those people who have cottages on the winter range or use the area for snowmobiling. The decrease in human disturbance might increase accessibility of food resources to deer, but it is doubtful. Public closure of lands in addition to those east of State Highway 209 is not recommended.

Reducing coyote numbers seems unwarranted at present. Their impact on the deer numbers seems minimal during mild winters. An extensive study of coyote activity in normal or severe winters would be needed before considering the possibility of predator control.

Reducing livestock numbers may be a feasible management technique. Cattle and sign of cattle activity can be observed on the south-facing slopes of the southeastern quarter of Section 7, on the ridgetops in Sections 7 and 8, and along Lost Prairie Creek. However, the numbers and food habits of livestock using the winter range are not known. An intensive study of the possibility of competition for forage by deer and livestock would have to be conducted before the restrictions on livestock use could be considered.

The other alternative is to log or burn parts of the winter range to influence successional stages of vegetation and improve the food supply for deer. Logging often causes an increase in shrub diversity and density according to Regelin et al. (1974). Drolet (1976) found small selective cuts are desirable on winter ranges. Small cuts adjacent to areas with dense overstory cover could be used by deer in severe winters. Steele (1953) found that Douglas-fir clearcuts on southwest exposures quickly developed dense shrub cover, and conifer regeneration was slowed. However, logging that would benefit wildlife is not often profitable for lumber companies (Pengelly 1963).

Broadcast burns can be used to improve stands of native vegetation (Eddleman 1972, Lyon 1971) and deserve serious consideration. If standing timber is not seriously affected by a properly executed burn, the chance of landowner approval would be enhanced. Various areas could be burned in the spring prior to new growth of vegetation to maintain the successional stages of understory vegetation. More information on deer food habits would be needed, and all site factors as well as densities of shrub species would have to be evaluated before the effect of burning could be determined for different sites on the study area. Southern and western aspects with overstory canopies that will not become closed within 30 or 40 years as in Sections 7, 8, 19, and 29 may warrant initial study since these areas are relatively snow-free. Development of food resources on these areas may redistribute the deer, easing pressure on other snow-free stress. Burning north-facing slopes could be considered, too, but only in areas that are first logged. Large cuts on north-facing slopes would retard reforestation. However, use of browse in these cuts would be restricted due to deep snow, so a compromise should be reached when deciding on the size of the cut. Intensive studies of the potential of broadcast burns should be initiated.

If broadcast burns are feasible on the winter range and adjacent areas, the impact of deer on new vegetation and regrowth should be considered before burns are attempted. High deer populations and/or harsh winters could cause severe overuse of new regrowth in burned areas. Development of new vegetation could be seriously slowed. A temporary reduction in deer numbers for a period of years may have to accompany broadcast burning to allow rehabilitation of the winter range.

CHAPTER VII

SUMMARY

White-tailed deer wintering in the Salmon Lake area were studied from October 1975 through September 1977. Intensive field work was conducted from January through March in 1976 and 1977.

Analyses of population characteristics included determination of numbers, the sex and age ratios, mortality, reproduction, physiological condition, and physical measurements. Whitetail numbers were estimated between 400 and 550 for the 19.06 square kilometers (7.36 sq mi) of whitetail winter range or 21 to 29 deer/square kilometer (54 to 75/sq mi). Fawn-adult ratios for 1976 and 1977 were 47 and 53:100, respectively. These ratios were similar to those for the entire Blackfoot Management Unit and indicated good fawn survival. Bucks comprised 65 percent of the adult harvest during either-sex hunting.

Hunter harvest was the major cause of mortality for this deer population during the mild winters of this study. Less than one-third of the population was harvested each year. Winter mortality was minimal during the past two winters and bone marrow compression tests indicated the four deer examined were not suffering from severe malnutrition.

An attempt to determine reproductive rates through analysis of estriol levels in deer urine was unsuccessful. However, all adult does necropsied were pregnant and one fawn carried a fetus. Conception dates of five fetuses ranged from 23 November through 4 December.

Analysis of food habits indicated that grasses and forbs were preferred. Shrubs receiving the greatest utilization included Oregon grape, chokecherry, serviceberry, and Rocky Mountain maple. Ponderosa pine, Douglas-fir, snowberry, and spirea were not used extensively.

Topo-cover types with steep slopes and moderate snow cover were used extensively. Slopes that were quick to develop snow-free areas and which had dense overstories adjacent to "sunning" areas were also preferred. Presence of heavily utilized shrub species, lightly utilized shrub species, and overstory density did not influence topo-cover type use.

The number of deer and the resources they use on the winter range are not in balance. A study of the feasibility of using broadcast burns to rehabilitate or expand the winter range is suggested.

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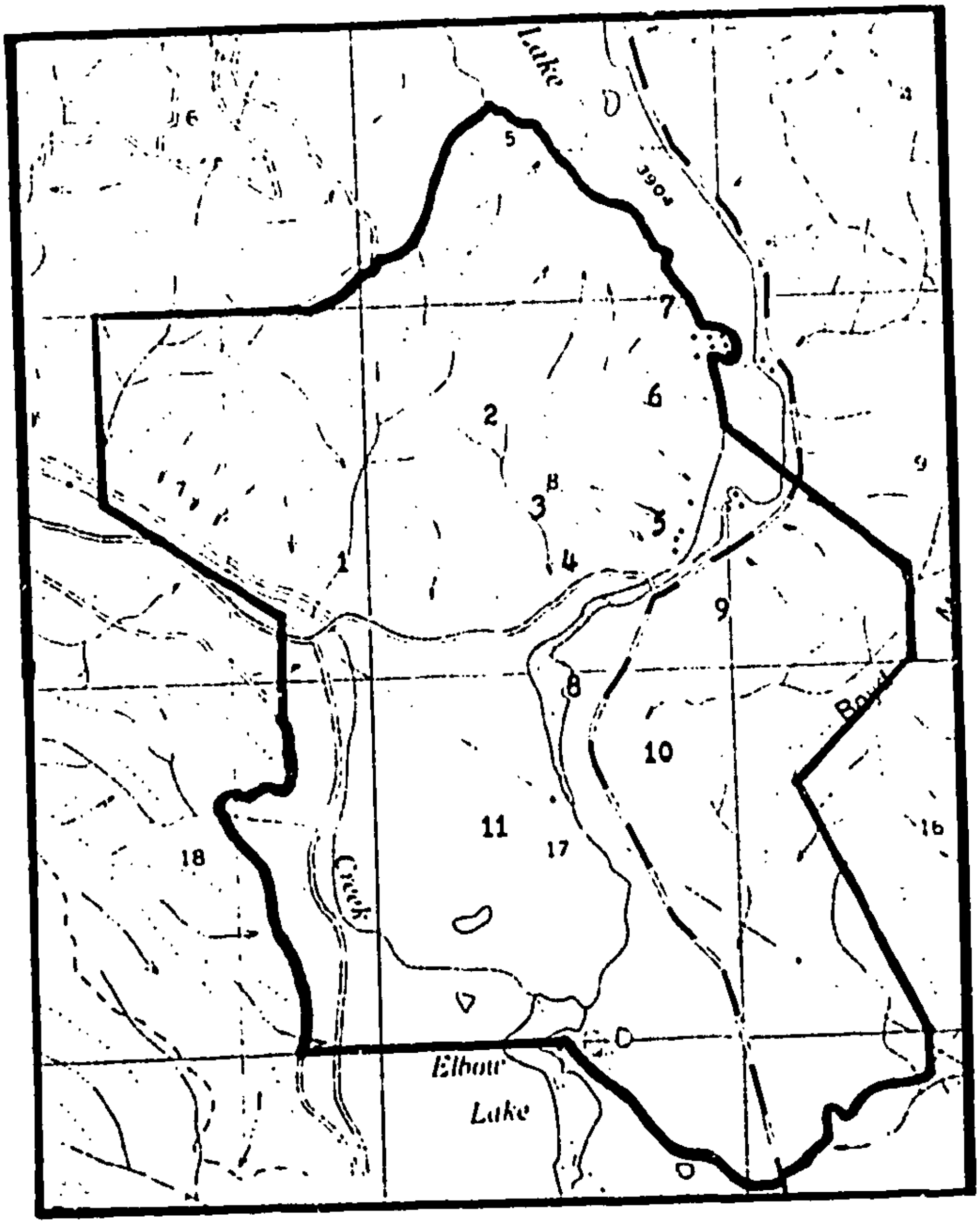
APPENDIX I

LOCATION OF BROWSE TRANSECTS

Fig. 7. Location of browse transects.



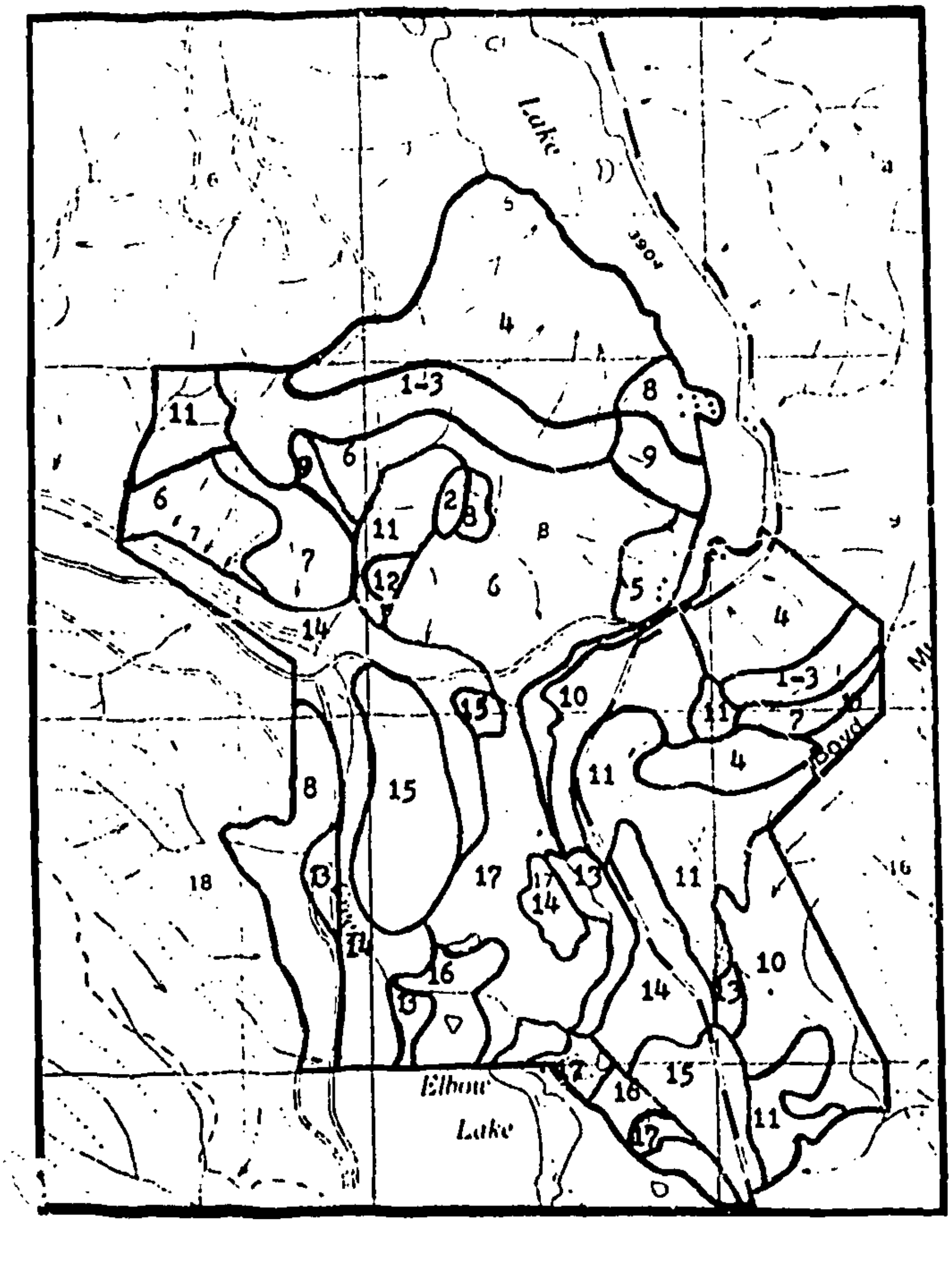
APPENDIX II

LOCATION OF TOPO-COVER TYPES ON THE STUDY AREA

II. Topo-cover type name.

topography	overstory	number
Ridge-top	dense	1
"	intermed.	2
"	open	3
North-facing	dense	4
South-facing	dense	5
"	intermed.	6
"	open	7
East-facing	dense	8
"	intermed.	9
West-facing	dense	10
"	intermed.	11
"	open	12
Lowland	dense	13
"	intermed.	14
"	open	15
Kettle-dome	dense	16
"	intermed.	17

Fig. 8. Location of topo-cover types on the study area.



APPENDIX III

DESCRIPTION OF TRAPPED DEER NOT RECOVERED BY SEPTEMBER 1977

III. Description of trapped deer not recovered by September, 1977.

Deer no.	Ear tag no.	Sex	Age	Collar description	Capture date
1	A3902 A3903	F	Ad.	Radio Ch. 9.2, Red and Yellow	1-76
3	A3910 A3911	F	Ad.	Radio Ch. 12.25, Brown and Yellow	1-76
5	A3912 A3925	M	F	Blue w/ white Y's	1-76
6	A3908 A3909	M	Ad.	Blue w/ white chevrons	1-76
8	A3916 A3917	F	Ad.	Blue w/ white ⊡'s	2-76
12	A3926 A3927	F	F	Blue w/ white X's	2-76
13	A3928 A3929	M	F	Blue w/ white vert. stripe	2-76
14	A3930 A3931	F	Ad.	Radio Ch. 2.22, Red	2-76
15	A3932 A3933	F	Ad.	Radio Ch. 7.18, Blue and White	2-76
16	A3934 A3935	F	F	Blue w/ white staggered dots	2-76
17	A3936 A3937	F	Ad.	Radio Ch. 7.48, Red, White, and Blue	2-76
18	A3938 A3939	F	F	Blue w/ white △'s	2-76
19	A3940 A3941	M	F	Blue w/ white +'s	2-76
20	A3942 A3943	M	Ad.	Blue w/ white □'s	2-76
21	A3944 A3945	F	Ad.	Blue w/ white 8's	2-76
22	A3946 A3947	M	F	Blue w/ white 7's	2-76
26	A3954 A3955	M	F	Blue w/ white dots	2-76
27	A3956 A3957	F	Ad.	Blue w/ white 2's	3-76
28	A3958 A3959	F	F	Blue w/ white vert. bars	3-76
29	A3960 A3961	F	Ad.	Blue w/ white deltas	3-76
31	A3964 A3965	F	Ad.	White w/ black dots	3-76

(continued)

Deer no.	Ear tag no.	Sex	Age	Collar description	Capture date
32	A3966 A3967	F	Ad.	White w/ black dots and horiz. bars	3-76
33	A3968 A3969	F	F	White w/ black vert. and horiz. bars	3-76
35	A3972 A3973	F	Ad.	White w/ black chevrons	3-76
36	A4000 A3974	M	Ad.	Blue w/ white squiggle	3-76
37	A3976 A3977	F	F	White w/ black 7's	3-76
38	A3978 A3979	F	Ad.	White w/ black ◬'s	3-76
39	A3980 A3981	F	Ad.	White w/ black ⧈'s	3-76
40	A3982 A3983	F	Ad.	Radio Ch. 11, Blue and Yellow	3-76
41	A3984 A3985	F	Ad.	Radio Ch. 2.45, Yellow	3-76
42	A3986 A3987	F	F	White w/ black squiggle	3-76
44	A3990 A3991	F	Ad.	White w/ black X's	4-76
47	A3994 A3995	M	Ad.	Yellow w/ black deltas	1-77
48	A3996 A3997	F	Ad.	Yellow w/ black dots	1-77
49	A3301 A3302	M	F	Yellow w/ black squiggle	2-77
50	A3303 A3304	M	F	Yellow w/ black H's	2-77
51	A3305 A3306	M	Ad.	Yellow w/ black staggered dots	2-77
52	A3307 A3308	F	Ad.	Yellow w/ black chevrons	2-77
54	A3311 A3312	M	F	Yellow w/ black X's	2-77

APPENDIX IV

PHYSICAL MEASUREMENTS OF WHITE-TAILED DEER

IV.A. Physical measurements of female white-tailed deer harvested in 1975

In Out[1] (+)(-)	Age	Kill date[2]	Weight, kg (lb) hog dressed	live wt.[3]	live wt. 1 Nov.[4,5]	Hind foot cm (in)	Total length cm (in)
+	1½	292					113.0 (44½)
+	1½	292					134.6 (53)
+	1½	292					125.7 (49½)
+	1½	297				44.5 (17½)	139.7 (55)
+	3½	299				44.5 (17½)	134.6 (53)
+	4½	216					146.1 (57½)
-	½	292					105.4 (41½)
-	½	298				36.8 (14½)	111.8 (44)
-	½	298				40.6 (16)	124.5 (49)
-	½	299				38.1 (15)	101.6 (40)
-	½	305				40.6 (16)	127.0 (50)
-	½	306				36.2 (14¼)	106.7 (42)
-	½	306				38.7 (15¼)	111.8 (44)
-	½	305				40.6 (16)	111.8 (44)
-	½	305				37.5 (14¾)	116.8 (46)
-	½	306				42.6 (16¾)	124.5 (49)
-	½	306				40.6 (16)	128.3 (50½)
-	½	306				41.3 (16¼)	113.0 (44½)
-	½	312				41.3 (16¼)	

(continued)

IV.A. (continued)

In Out (+)(-)[1]	Age	Kill date	hog dressed	Weight kg (lb) live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
-	½	312	29.03 (64)	36.17 (80)	36.17 (80)	43.2 (17)	121.9 (48)
-	½	312	23.59 (52)	29.80 (66)	29.80 (66)	39.4 (15½)	115.6 (45½)
-	½	313	24.49 (54)	30.85 (68)	30.85 (68)	38.1 (15)	113.0 (44½)
-	1½	292					120.7 (47½)
-	1½	292					134.6 (53)
-	1½	298				44.5 (17½)	128.3 (50½)
-	2½	312	41.28 (91)	50.50 (111)	51.98 (115)	47.0 (18½)	135.9 (53½)
-	3½	292					147.3 (58)
-	4½	292					132.1 (52)
-	4½	305				45.7 (18)	148.6 (58½)
-	4½	306					171.5 (67½)
-	5½	297				48.3 (19)	134.6 (53)
-	6½	306				48.3 (19)	141.0 (55½)
-	8½	292					146.1 (57½)
-	8½	298				44.5 (17½)	154.9 (61)
-	10½	312	47.63 (105)	57.93 (128)	58.56 (129)	47.0 (18½)	153.7 (60½)
-	14½	306				47.6 (18¾)	152.4 (60)
-	Ad.	298				45.7 (18)	134.6 (53)

[1] + means deer harvested from area used as summering range by deer wintering at Salmon Lake.
- means deer harvested from other areas in Blackfoot Management Unit.

(continued)

IV.B. Physical measurements of female white-tailed deer harvested in 1976.

In Out (+)(-)	Age	Kill date	Weight kg (lb) hog dressed	live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
+	½	305	22.68 (50)	28.74 (63)	28.74 (63)	39.4 (15½)	110.5 (43½)
+	5½	298				53.3 (21	
-	½	301				39.4 (15½)	111.8 (44)
-	½	312	24.04 (53)	30.33 (67)	30.33 (67)	41.9 (16½)	116.8 (46)
-	3½	303	55.79 (123)	67.47 (149)	67.31 (148)	47.0 (18½)	148.6 (58½)
-	3½	305	44.45 (98)	54.21 (120)	54.21 (120)	48.3 (19)	135.9 (53½)

Footnotes (continued)

[2]Julian Calendar.

[3]Live wt. = 2.20 + 1.170 (dressed wt.), from J. L. Roseberry and W. D. Klimstra. 1975. J. Wildl. Manage. 39(1):48-58.

[4]Formula from p. 437 in A. N. Moen. 1973. Wildlife ecology. W. H. Freeman and Co., San Francisco. 458 pp.

[5]Live wt. of fawns assumed constant throughout fall, 1 Nov. wt. for deer 5½ and older determined with same formulas used for deer 4½ years old. D. L. White. 1968. Condition and productivity of New Hampshire deer. In: H. R. Siegler, ed. The white-tailed deer of New Hampshire. NH Fish Game Dept., Concord. 256 pp.

IV.C. Physical measurements of male white-tailed deer harvested in 1975.

In Out (+)(-)	Age	Kill date	Weight kg (lb) hog dressed	live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
+	½	292					114.3 (45)
+	½	292				41.9 (16½)	114.3 (45)
+	½	298				41.3 (16¼)	114.3 (45)
+	½	299				41.3 (16¼)	116.8 (46)
+	½	305				40.9 (15¾)	113.0 (44½)
+	1½	297					129.5 (51)
+	1½	297					128.3 (50½)
+	1½	294					
+	1½	306				47.6 (18¾)	138.4 (54½)
+	1½	300					
+	1½	313	54.88 (121)	66.41 (146)	68.58 (151)	42.6 (16¾)	141.0 (55½)
+	5½	292					157.5 (62)
+	5½	293					
+	5½	312	76.66 (169)	91.89 (203)	92.52 (204)	50.2 (19¾)	165.1 (65)
+	6½	297					
+	Ad.	292					
-	½	292					113.0 (44½)
-	½	299				41.9 (16½)	115.6 (45½)
-	½	312				39.4 (15½)	100.3 (39½)
-	1½	298				45.1 (17¾)	144.8 (57)

(continued)

IV.C. (continued)

In Out (+)(-)	Age	Kill date	Weight kg (lb) hog dressed	live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
-	1½	297					
-	1½	297				47.0 (18½)	139.7 (55)
-	1½	299	50.35 (111)	61.11 (135)	67.97 (150)	45.7 (18)	135.9 (53½)
-	1½	299				46.4 (18¼)	138.4 (54½)
-	1½	299				45.7 (18)	144.8 (57)
-	1½	305				45.7 (18)	128.3 (50½)
-	1½	312					
-	1½	312					
-	1½	328	50.35 (111)	61.11 (135)	67.97 (150)	47.0 (18½)	147.3 (58)
-	1½	318					
-	2½	306				50.8 (20)	144.8 (57)
-	2½	299					
-	3½	292					142.2 (56)
-	3½	292					149.8 (59)
-	4½	299					
-	5½	313	97.07 (214)	115.77 (255)	116.48 (257)	52.7 (20¾)	180.3 (71)
-	6½	299					
-	7½	292					
-	9½	313	88.00 (194)	105.16 (231)	105.87 (233)	52.1 (20½)	152.4 (60)
-	9½	325					
-	10½	299				50.2 (19¾)	163.8 (64½)

IV.D. Physical measurements of male white-tailed deer harvested in 1976.

In Out (+)(-)	Age	Kill date	Weight kg (lb) hog dressed	live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
+	1½	298	51.26 (113)	62.17 (137)	60.17 (133)	47.6 (18¾)	133.4 (52½)
+	1½	319	51.26 (113)	62.17 (137)	66.17 (146)	48.3 (19)	135.9 (53½)
+	1½	319	60.33 (133)	72.79 (160)	76.79 (169)	50.8 (20)	153.7 (60½)
+	1½	332	47.17 (104)	57.39 (127)	65.11 (144)	50.2 (20)	141.0 (55½)
+	2½	325	56.25 (124)	68.01 (150)	81.45 (180)	49.5 (19½)	161.3 (63½)
+	5½	298					
+	5½	325	83.92 (165)	100.39 (221)	107.80 (238)	53.3 (21)	162.6 (64)
+	7½	298	104.78 (231)	124.79 (275)	122.20 (269)	51.4 (20¼)	167.6 (66)
+	7½	299	96.62 (213)	115.25 (254)	113.02 (249)	51.4 (20¼)	168.9 (66½)
+	8½	326				51.4 (20¼)	
-	½	298	30.84 (68)	38.28 (84)	35.69 (79)	41.9 (16½)	119.4 (47)
-	1½	301				46.9 (18½)	163.8 (64½)
-	1½	298	61.69 (136)	74.38 (164)	72.38 (160)	48.3 (19)	157.5 (62)
-	1½	301				42.6 (16¾)	
-	1½	304	53.52 (118)	64.82 (143)	64.54 (142)	47.0 (18½)	141.0 (55½)
-	1½	305	39.01 (86)	47.84 (105)	47.84 (105)	44.5 (17½)	132.1 (52)
-	1½	312	51.26 (113)	62.17 (137)	64.17 (141)	45.7 (18)	114.8 (45)
-	1½	319	52.16 (113)	63.23 (139)	67.23 (148)	49.5 (19½)	144.8 (57)
-	1½	325	46.27 (102)	56.34 (124)	62.06 (137)	47.0 (18½)	141.0 (55½)

(continued)

IV.D. (continued)

In Out (+)(-)	Age	Kill date	Weight kg (lb) hog dressed	live wt.	live wt. 1 Nov.	Hind foot cm (in)	Total length cm (in)
-	3½	305				46.4 (18¼)	
-	4½	298	74.39 (164)	89.24 (197)	83.54 (184)	48.9 (19¼)	167.6 (66)
-	4½	326	77.57 (171)	92.96 (205)	110.06 (243)	45.7 (18)	166.4 (65½)
-	6½	326	64.41 (142)	77.56 (171)	85.33 (188)	49.5 (19½)	163.8 (64½)
-	7½	332	83.01 (183)	99.32 (219)	109.32 (241)	48.3 (19)	168.9 (66½)
-	8½	298	100.25 (221)	119.49 (263)	116.90 (258)	48.3 (19)	165.1 (65)
-	Ad.	324					
-	Ad.	325	76.66 (169)	91.89 (203)		47.6 (18¾)	157.5 (62)

IV.E. Antler points and antler beam diameters of white-tailed deer harvested in 1975 and 1976.

In Out (+)(-)	Age	No. of points	Avg. Diameter mm	(in)
+	1.5	7	24	15/16
+	"	4		
+	"	4		
+	"	2	21	13/16
+	"	3		
+	"	3	22	14/16
+	"	4	19	12/16
+	"	4	19	12/16
+	"	8	22	14/16
+	"	6	19	12/16
+	2.5	8	22	14/16
+	5.5	9	46	1 13/16
+	"	8		
+	"	7	32	1 4/16
+	"	8		
+	"	9	33	1 5/16
+	6.5	9		
+	7.5	11		
+	"	10	33	1 5/16
+	8.5	10	38	1 8/16
-	1.5	8	29	1 2/16
-	"	4		
-	"	5	24	15/16
-	"	3		
-	"	2	22	14/16
-	"	4	22	14/16
-	"	2	17	11/16
-	"	4		
-	"	4		

(continued)

IV.E. (continued)

In Out (+)(-)	Age	No. of points	Avg. Diameter mm	(in)
-	1.5	5	22	14/16
-	"	6		
-	"	5	19	12/16
-	"	6	19	12/16
-	"	2		
-	"	4	17	11/16
-	"	4		
-	"	7	19	12/16
-	"	6	21	13/16
-	"	8	19	12/16
-	2.5	4	30	1 3/16
-	"	6		
-	3.5	6	27	1 1/16
-	"	8	30	1 3/16
-	"	6	22	14/16
-	4.5	11	35	1 6/16
-	"	9		
-	5.5	10	39	1 9/16
-	6.5	8		
-	"	10		
-	7.5	8	36	1 7/16
-	"	10	32	1 4/16
-	9.5	9	38	1 8/16
-	"	10	44	1 12/16
-	10.5	8	37	1 7/16

IV.F. Physical measurements of trapped deer, January through April 1976 and 1977.

Day	Year	Deer no.	Age	Sex	Weight kg (lb)	Hind foot cm (in)	Heart girth cm (in)
037	1976		½	M	31.8 (70)		
069	"		½	F	32.7 (72)		
075	"	36	Ad	M	70.3 (155)		
075	"	11	1½	M	41.3 (91)		
080	"	37	½	F	37.2 (82)		
080	"	9	Ad	F+M	71.7 (158)		
081	"	39	Ad	F	57.2 (126)		
081	"	38	Ad	F	61.2 (135)		
081	"	27	Ad	F	56.7 (125)		
083	"	30	½	F	29.9 (66)		
086	"	4	Ad	F	35.8 (79)		
086	"	1	Ad	F	55.3 (122)		
093	"	3	Ad	F	57.2 (126)		
093	"	5	½	M	31.1 (70)		
098	"	28	½	F	21.8 (62)		
098	"	40	Ad	F	59.0 (130)		
028	1977	46	½	F		41.9 (16½)	80.0 (31½)
028	"	47	1½	M		43.2 (17)	91.4 (36)
032	"	48	Ad	F		45.7 (18)	96.5 (38)
040	"	49	½	M		43.2 (17)	90.2 (35½)
042	"	50	½	M	33.6 (74)	45.7 (18)	82.6 (32½)
042	"	5	1½	M	57.2 (126)	50.8 (20)	100.3 (39½)
046	"	34	Ad	F	48.5 (107)	47.0 (18½)	96.5 (38)
051	"	51	Ad	M		50.8 (20)	104.1 (41)
053	"	52	Ad	M		52.1 (22½)	95.3 (37½)
055	"	53	½	M	30.8 (68)	40.6 (16)	90.2 (35½)
060	"	54	½	M	35.4 (78)	41.9 (16½)	87.6 (34½)
061	"	36	Ad	M	81.7 (180)	48.3 (19)	116.8 (46)
076	"	15	Ad	F	55.3 (122)	46.4 (18½)	99.1 (39)
080	"		Ad	F	45.4 (100)	48.3 (19)	92.1 (36½)